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ANNUAL REPORT

OF THE

COMMISSIONER

OF

MINERAL STATISTICS

OF THE

STATE OF MICHIGAN,

FOR 1880.

BY AUTHORITY.

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OFFICE OF COMMISSIONER OF MINERAL STATISTICS,
Marquette, Michigan, June, 1881.

HON. DAVID H. JEROME, *Governor of Michigan:*

SIR,—Herewith, in compliance with law, I have the honor to submit the annual report of the Commissioner of Mineral Statistics, for 1880.

Part I is taken up with the copper district. Commencing with the earliest period the development of the region is traced to the present time. An account, historical and descriptive, is given of all its copper mines and other important industries and resources. Much pains have been taken to make the sketches of the copper mining companies as complete and accurate as possible. In collecting the requisite information, aside from a personal examination of the mines, recourse has been had to the printed reports of the companies, to published accounts relating to the early history of the country, to geological reports, etc.; also numerous facts have been furnished by the old residents and mining men.

In order to render the report on the copper district more satisfactory and complete, longitudinal sections of many of the copper mines have been added. These sectional maps are drawn to a scale and each one shows the underground workings of the mine represented up to the close of 1880. These maps thus brought together in this accessible form will be found, it is believed, to be exceedingly valuable as a matter of comparison. They also illustrate, in a measure, the written descriptions, and will enable those who are familiar with this most interesting and important industry to better understand the methods pursued in the prosecution of underground mining work. This portion of the report was prepared by Prof. C. D. Lawton, who spent several months for me in the copper district.

Part II relates to the iron industry and includes a description of nearly all the iron mines of the State. To Prof. Lawton was also allotted the task of examining and writing up some of the iron mines.

At the close of Parts I and II will be found statistical tables of the copper and iron ore mines.

There has also been incorporated some pages of statistics taken from the preliminary report upon the Iron and Steel Industries of the United States from the tenth census of the U. S. These statistics were collected and published by Mr. James M. Swank, special agent of the census office, and are herewith given with his consent.

I am, very respectfully, your obedient servant,

CHAS. E. WRIGHT,
Commissioner.

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EARLY HISTORY.

Prior to the admission of Michigan as one of the States of the Federal Union, the Territory claimed as a valued portion of its domain a strip of land bordering on Lake Erie, in which was included the now flourishing city of Toledo. The right of possessing this parcel of land was insisted upon with equal strenuousness by the State of Ohio, and when, in 1835, a convention assembled at Detroit and formed a constitution defining the boundaries of the proposed State, and comprised within them this disputed territory, so great did the excitement become that men upon both sides began to arm and to organize for a conflict, that for a time it seemed must inevitably occur. The matter coming before Congress on the application of Michigan to become a State, that body passed an act admitting her into the Union upon condition that she should relinquish her claim to the disputed territory.

A sugar-coating was given to this bitter pill by offering to her people, in lieu of the coveted territory so strenuously claimed, the isolated and little regarded region known as the Upper Peninsula.

A convention being called soon after, these conditions were indignantly rejected; but a second convention, acting upon the matter in December of the same year, concluded discretion to be the better part of valor, and reluctantly accepted the proviso, and in January thereafter (1837) Michigan was admitted into the Union.

Thus it is exactly 44 years since the Upper Peninsula was given to Michigan by Congress as the final settlement of a serious dispute; it was thrown in, not as possessing intrinsic value, but to soothe the pride of an irritated people. The magnificent territory thus acquired was given as an offset to a mere strip of land insignificant in comparison, yet which was nevertheless regarded as of far greater value. But slowly the people of our State have awakened to a knowledge of the magnitude of their gain in the exchange which was thus thrust upon them. We are coming to realize that our State possesses in this northern peninsula one of the most wonderful and valuable regions within the limits of the national domain. Rich it is in minerals in an unparalleled and almost to an incredible degree, producing ores of iron unsurpassed in quality and unequaled in richness, and native copper in an abundance and of value found nowhere else.

The possession of this country, known as the region of Lake Superior, as a portion of the territory of the United States is said to be due to Dr. Franklin, who, while in Paris, in the days of the American Revolution, representing the interests of the struggling colonies, became acquainted through the records of the government departments to which he had access, with the reports that had been made concerning the existence of copper along the margin of the Great

Lake; and thus conceiving the region to possess a possible mineral value that would be available at some future period, he subsequently in arranging the treaty with England, in which she acknowledges our independence, drew the boundary line so as to include the south shore of Lake Superior within the limits of the new nation.

Remote as this region comparatively yet remains, even after the lapse of two centuries and a half since it was first visited by the zealous representatives of the French nation, it was in fact the earliest discovered portion of our great Northwest. But while other and apparently more favored sections became the marts of commerce and teemed with civilized life, it was two centuries after the advent of the white man before the waters of the Great Lake bore other than the canoe of the red men or of the venturesome *voyageur*; And the primitive solitude of the sombre forests which skirt its borders remained equally unbroken. The motive that stimulated the early discoverers to penetrate to this far-off coast was other than mercenary. They came simply as the representatives of the cross, and sought only the spiritual conversion of the Indians. Zealous to spread the faith among these rude savages, the Jesuit fathers explored the rock bound coast of the Great Lake upon which they were the first to enter and fearlessly penetrated the trackless wilderness which surrounds it, meeting innumerable dangers and perils—even death itself—with simple but undaunted courage.

Vain and futile as their efforts proved to be in behalf of the cause which they labored to promote, they yet builded better than they knew. The record of their adventures and discoveries, inscribed by their own hands, constitutes an imperishable monument to their memory. The volumes containing the manuscripts of these Catholic missionaries, who traversed the shores of Lake Superior during the time of French supremacy, comprise all that is known of the early history and discoveries in the Northwest.

The religious impressions which the teachings of these worthy missionaries made upon the savage mind faded and disappeared when the presence of those who had inculcated them was withdrawn. These pious doctrines found no sustaining element in this uncongenial soil, and the church which the missionaries had sought so zealously to establish, like the house that was built upon the sand, soon crumbled into fragments. And were it not for the written accounts which have been given of their undertakings there would be naught to show that their efforts had ever been made.

But while the priests met with no measure of permanent success in behalf of the immediate object of their labors, they yet, fortunately for the historian, transmitted to writing accounts of their journeys and of their observations, and these "relations," which were preserved and have been published, are justly esteemed among the most invaluable contributions to the early history of our country.

The first exploration of the country bordering on Lake Superior was undertaken by Charles Raymbault and Isaac Jogues, two Jesuit priests, who, with a party of Hurons, landed at the Sault de Ste. Marie in the fall of 1641. Here they met a large body of Indians encamped upon the banks of the river engaged in catching fish in the rapids, and from them they learned that these waters were the outflow of a great lake lying beyond, which they designated as Kitchigummi, or Big Lake, as it exceeded, as they declared, in dimensions any other of the great lakes.

In the following year, Raymbault, having died at Quebec from the effects of his previous exposures, Jogues set out with some Huron attendants to revisit

the Sault, and to extend still further his knowledge of the country and his intercourse with the tribes who inhabited it; but almost at the outset of his expedition, himself and party were captured by the Mohawks, and after suffering the most cruel torments, short of death, and witnessing the burning of his companions at the stake, he was finally ransomed by the Dutch, at Albany, whence he proceeded to France, but soon after, with unabated zeal, he returned to the scene of his former labors.

Pierré Mesnard set out from Quebec in 1660, and having arrived at the Sault, proceeded in his canoe along the south shore of the lake to the head of Keweenaw Bay, where he remained through the winter, laboring to promote the spiritual welfare of the Indians. In the following summer, accompanied by a single Indian, he entered Portage Lake intending to cross the peninsula and to push westward along the shore beyond; but while his guide was engaged in conveying the canoe across the Portage the good father wandered into the woods and no trace of him was ever afterwards obtained.

In 1666 Claude Allouez established a mission at La Pointe, in Chaquomegon Bay, where he remained for two years extending his travels and his teachings among the Indians who gathered in great numbers to listen to his wonderful disclosures.

Allouez makes mention of the veneration in which the lake is held by the savages who worship it, he says, as a divinity, and he also states that he has observed that they have in their possession pieces of copper, which are sometimes of a considerable size, which they esteem as domestic gods.

Claude Allouez returned to Quebec to secure aid for his mission, but such was his zeal that in two days thereafter he again started to go back to the scene of his labors.

Two years subsequent to the establishment of his mission at La Pointe, James Marquette and Claude Dablon founded a permanent mission at the Sault de Ste Marie, and from this period the place dates its settlement, making it thus the oldest within the State. A grand council with the Indians was held and formal possession of the country was taken in the name of the King of France.

In 1690 two of the Jesuit fathers made a map of the Lake which was published in Paris three years later. A copy of this map is contained in Foster & Whitney's report, and shows with what care these men must have explored the coast which they thus represented. Since considering the great extent of the coast to be traversed, and their utter want of facilities to accomplish such a task other than their own almost unaided powers of observation, this graphical delineation of the outlines of the Great Lake is indeed a marvel of accuracy.

Mesnard, Marquette, and Dablon were overtaken by death while in the midst of their labors and their bodies became mingled with the dust of the rude land they had discovered; but their names deserve to be cherished with the memory of those who gave all in their zeal to promote the welfare of the poorest of their fellow men.

The occurrence of copper was one of the objects that early attracted the attention of the Jesuits, and its presence, so frequently met with among the Indians, naturally excited their curiosity and wonder. Frequent mention of it is made, and in some instances the descriptions relate to masses of considerable size. But long prior to this period, the metal that attracted the attention of the missionaries and early *voyageurs*, and which now forms the basis of a great and growing industry, had been sought and mined for by a people who have left no record but the implements which they used and the excavations which

they made. These excavations the slow accumulations of debris during the years which have since elapsed had obscured from view, and the Indians, whom the good fathers labored to christianize, had no knowledge whatever of the matter. No suspicion that any such work had ever been performed occurred until within a recent period, after the country was thrown open to settlement and actual mining had begun. Then it became known that this ground had been previously occupied, and that these metalliferous veins had been long ago extensively worked and apparently large amounts of copper obtained; but when and by whom is a mystery. But that this mining work is of a high antiquity is evident from many facts; the pits and tunnels which had been made had become filled up with rubbish and with decayed vegetation and grown over with forest trees. If the depressions were ever observed they were naturally regarded as those made by overturned trees or as hollows in the rocks, and it was not suspected until the discovery was actually made, so late as 1847–48, that here, too, men had formerly delved in search of metals. These ancient excavations are found in all portions of the Mineral Range and in Isle Royal. So general is this fact, that there is scarcely a vein or outcrop of mineral in the whole copper district but the evidences are found of their ancient workings, extending into the solid rock from a few feet to sixty feet in depth. In these pits, when cleared of the accumulated dirt and rubbish, have sometimes been found large masses of copper which these primitive seekers had unsuccessfully endeavored to remove. Masses of copper of many tons' weight have thus been discovered surrounded with stone hammers in great numbers, pieces of burnt wood and other evidences of former labor. The method of mining which these people apparently pursued was to heat the rock with fire and then by pouring on water and pounding the rock with their stone hammers to disintegrate and separate it.

Quantities of these stone hammers are nearly always obtained from the bottoms of these ancient pits. They consist of small boulders of hard trap rock of from three to thirty pounds in weight, around which a groove has sometimes been made for the purpose of holding a withe which fastened on the handle. Copper tools and other utensils and materials have also been found, but no indications that would lead to the identification of the race to which these miners belonged, have been, as yet, discovered.

These ancient "diggings," as they are locally called, are everywhere so abundant and have now become so well known and familiar to those engaged here in mining as to be no longer a matter of surprise or wonder. In one respect they have undoubtedly been of great service, serving as guides which have led to the discovery of lodes, which were thus shown to have been previously worked and as indicative of the value of such lodes.

As in the iron region, the magnetic needle has guided to the discovery of many valuable deposits of ore, so in the copper district these pits of the ancient miners extending along the surface outcrop of the copper bearing veins, have silently betokened to the eager explorer where was hidden the object of his search. But to the Indians who roamed the country at the time of its discovery, to the Jesuits, and to the early *voyageurs* and explorers this fact of ancient mining was wholly unknown. The evidence of the existence of copper in this region—a knowledge which had already become wide-spread—was derived from the specimens in the possession of the Indians and from seeing the erratic boulders of that metal which were sometimes found in traversing the country, and from observing the copper bearing veins which outcropped along the streams and near the shore of the lake.

Among those who early visited this country was Alexander Henry, who came to Mackinaw in about 1760 for the purpose of traffic with the Indians. Henry was a man of intelligence and education, and spent many years in this country, meeting with numberless adventures and actively engaged in various undertakings. He subsequently published a well written and interesting narrative of his experience and his observations in the country. Henry became familiar with the fact of the existence of copper in the country, and, as he thought, of more precious minerals also. He describes the great copper rock, an erratic boulder or mass of native copper which lay in the margin of the Ontonagon River, about 20 miles above its mouth, at the foot of a high bluff, from which it had rolled down or had been brought to the spot by some transporting agency, and which he describes as probably weighing five tons. Ten years thereafter Henry was chosen the agent of a company organized in England to conduct practical mining work in Lake Superior, and after some preliminary examinations elsewhere, selected this location as the seat of his operations. To this place he proceeded in the fall of 1770, with a small party of miners, in a vessel which he had previously built at the Sault. He himself soon after returned to the Sault, leaving his men to work through the winter. In the spring he sent his barge with provisions to the relief of his men, but was soon after surprised to see the vessel return with the whole party aboard. They had drifted into the bluff a distance of about 40 feet, and failing to secure the work, in the spring, when the frost went out and the ground became loosened, the walls fell in, and the miners, realizing the futility of the undertaking at that point, decided to abandon the work. Some copper was obtained, possibly chipped off from the great boulder. A second attempt was made, equally unsuccessful, but conducted upon the north shore of the lake. Here they punctured the rock to a depth of 30 feet in a vein that rapidly narrowed as they proceeded downward, until it nearly disappeared. Satisfied that nothing was likely to be gained here, and his associate members refusing to advance any more money, further effort was relinquished. What copper had been obtained was sent to England, and the vessel and other company property were sold to pay the debts. The parties to this enterprise, the first mining undertaking in the Lake Superior country within historical times, were His Royal Highness the Duke of Gloucester, Mr. Secretary Townshend, Sir Samuel Touchet, Mr. Baxter, Consul to the Empress of Russia, Mr. Cruickshank, Sir William Johnson, Mr. Bostwick, and Alexander Henry. A charter was applied for and granted, but never taken from the seals office.

Henry, in reflecting upon the matter, states that the country must be settled and peopled before mining can be carried on to advantage. He avers that the soil is productive and will grow good crops, and cites some facts to corroborate the statement, among which he says he distributed seed corn among the Indians, which they planted and which yielded well, though he thinks them too improvident to preserve their seed from year to year.

Capt. Jonathan Carver published in 1796 an account of three years' travel in this country, in which he speaks of the Ontonagon River as a stream of considerable size that flows into the lake, the head of which is composed of an assemblage of small streams. He declares the river to be remarkable for the abundance of virgin copper, which is found near its banks, and states that this metal is also met with elsewhere in the country. He opines that at some future period it may furnish the basis of a profitable industry, and relates how the metal may be carried in vessels to the Sault, thence around the rapids and

re-shipped to Niagara Falls, here another portage to a point below the Falls, whence it may be conveyed to Quebec or elsewhere.

It was not until 1796 that Michigan came into possession of the American government, and the uncertainty of affairs, the trouble with the English government and with the Indians prevented any effort being made towards the exploration or settlement of the Territory, much less of the Lake Superior country. In 1818–19 the survey of Michigan was begun, a delegate was sent to Congress, some important Indian cessions made, and the lands thrown open to sale. And in the latter year Gen. Lewis Cass, the Governor of the Territory, proceeded, under directions from the War Department, on a tour of inspection, which included the south shore of Lake Superior. This expedition was accompanied by Mr. H. R. Schoolscraft in the capacity of geologist, etc., and he had for his object an especial purpose to determine as far as possible the truth of the reports regarding the mineral value of the country. In 1820 Mr. Schoolscraft published an account of the journey, and this volume, now rarely met with, contains much interesting matter.

The party entered the mouth of the Ontonagon River in July and proceeded up the stream a distance of twenty miles and upwards, to view the celebrated copper rock previously spoken of, the fame of which had reached their ears. He speaks of finding copper along the banks of the river, and that La Houton, Charlevoix, Carver, and McKenzie have successively noted the same remarkable fact and published accounts thereof which had given to the stream a notoriety which it would not otherwise have possessed. Many of the reports regarding the minerals found in the country referred especially to this river, but nothing very definite was known and it was for the purpose of endeavoring to determine the facts that they entered the river.

The party experienced excessive difficulty in ascending the rapids and in climbing over the range with the thermometer indicating at 90° in the shade, and with the swarms of musquitoes and flies attacking them. The General, who remained in the boat, became exhausted; however both divisions of the party finally reached their destination and found the object of their search.

The size of the rock scarcely met their expectations, still Mr. Schoolscraft thought it a remarkable object and one well worth the journey to see. It evidently had been frequently visited since it bore the marks of much pounding and many cuts, and broken tools lay strewn about. The mass had apparently been removed some distance from its original bed as the adhering rock, mainly serpentine, was foreign to the vicinity; its whole appearance, the intimate association of the metal and the matrix, pointed to a common and contemporaneous origin.

This mass of native copper, which up to the period of its removal was the largest known in the world, was, in the spring of 1842, taken to the mouth of the river by James Paull who came to the country from the lead mines of Wisconsin for that purpose. Paull prepared a truck car upon which he hoisted the rock and succeeded in drawing it over the range by using a windlass, taking it to a point below the rapids and thence conveying it to the mouth of the river on a flat boat. The mass was soon after sold to a Mr. Eldridge who in turn sold it to the U. S. Government, and it has since been on the grounds of the War Department, at Washington. Paull claims to have bought of an Indian a second mass of copper of about 800 lbs. weight, which was found on the west shore of the peninsula, above the Portage, and which he took to Copper Harbor, whence, he thinks, it found its way into the cabinet of Yale College.

Paull remained at Ontonagon where he still resides, and was thus the first permanent resident in the copper region.

By a succession of treaties made with the various Indian tribes in 1836, 1837 and 1842, the lands comprising the Lake Superior district were ceded to the United States, and all Indian claims thereto were finally extinguished. Immediately thereafter large numbers of persons proceeded to the country with authority from the Government to mine on the lands of the newly acquired territory.

Public attention had been recently awakened to the copper deposits of the northern peninsula through the first published report of Dr. Houghton, who, having been appointed geologist of the newly made State, eagerly entered upon the active prosecution of his labors extending his geological observations to the shores of Lake Superior, and in 1841 submitted to the Legislature the results of this preliminary examination. In this report the prominent geological features of country were ably outlined, and the first definite information regarding the occurrence of copper and the character of the deposits was given to the world.

Dr. Houghton, a few years later, entered upon the prosecution of a detailed survey of the entire Upper Peninsula, upon a plan which he successfully inaugurated, but the fulfillment of which was unfortunately prevented by his untimely death, by drowning, which occurred on the 13th of October, 1847, near the mouth of Eagle River, in Keweenaw Co. With him was thus lost to the world the valuable results of his extended observations, and the system which he had devised of combining with the government linear survey of the country, geological and other scientific work was gradually abandoned.

But his previous announcements had already drawn the public attention to the country. The copper district was now swarming with speculators, prospectors and explorers, and the rocks were being everywhere perforated with incipient mining.

The first operations were undertaken under grants or permits obtained from the War Department, of which about 1,000 in all were issued, and 960 locations actually made. The essential conditions of these leases were that the lessee, or his assigns, etc., should, during the first three years, pay to the government six per cent of all metal produced; at the expiration of that period the lease could be renewed, at the option of the holder, for an additional three years on condition of payment to the government of ten per cent of the mineral obtained, at the end of which time the lease could be further extended for the same length of time on the same conditions, unless Congress should otherwise dispose of the lands. Very many of these locations were made along the Keweenaw peninsula, and this portion of the country became the seat of the earliest mining work, and for some years before operations were conducted elsewhere to any extent this immediate region was teeming with active industry.

KEWEENAW COUNTY.

The mineral range in this county, which begins at the extremity of Keweenaw Point and trends westerly a distance of about twenty miles, and thence southwesterly, is characterized by the occurrence of a broad belt of green stone or semi-crystalline trap, which forms the southern escarpment or wall in this portion of the range.. This greenstone formation terminates at about the south line of the county, and does not again appear throughout the further prolongation of the mineral range. The greenstone has a northerly and northwest-

erly dip, corresponding with the other belts of this portion of the range, of about 24° to 30° to the horizon, and attains an elevation above the lake of about 800 feet. From the top of the range the land slopes with a general gradual descent to the north and to the west to the lake, which is distant in this direction from two to three miles. On the south side the elevation drops abruptly a distance of one to two hundred feet to a low lying plane which forms the valley of the Eagle River and other streams, and which reaches to the east till it meets the foot of a second range of hills having a trend generally parallel with the principal elevation, and known as the Southern or Bohemian range. This portion of the range, as far as the greenstone extends, is frequently crossed by veins having a nearly vertical dip and a lateral direction generally at right angles to the formation and a width of from one foot to three feet, and have been found to carry copper sometimes in extraordinary quantities, some of them having proved among the most remarkable deposits of copper that the world has revealed.

Both north and south of the greenstone are numerous amygdaloid beds, which are crossed by the fissure veins, and which usually carry a greater or smaller percentage of copper. There are also found in some portions, immediately underlying the greenstone and further to the south, beds of conglomerate, which in some instances contain copper in workable quantities. But surpassing all these, except the fissure veins, the most important of the copper bearing deposits of this district is what is known as the ash bed, a scoriacious amygdaloid bed lying north of the greenstone, having a varying width of from five to twenty feet, and yielding at favorable points about one per cent of copper.

This ash bed, as it is called, through the invention and use of the compressed air drill, high explosives and greatly improved stamping and washing apparatus, seems likely to become the basis of the future mining prosperity of Keweenaw county, although in the past all attempts to work it at a profit have proved ruinous to the companies engaged in the undertaking.

In the earlier period of copper mining on Lake Superior, the fissure veins, yielding copper in masses, were the ones which gave to the country its celebrity, and the ones in which the mining operations were attended with profit, and of these the most noted and the most productive lie south of the greenstone—an important feature of this region geologically as well as geographically.

As before remarked, what has proven to be, thus far, the great copper-bearing belt of Keweenaw county, lies immediately south of greenstone and pitches beneath it. In this belt are situated the Cliff, Phœnix, Central, Delaware and many other noted mines which have produced the greater portion of the copper obtained.

South of this copper-bearing range which underlies the greenstone, is another belt having a parallel direction but of an entirely different character, and too lean in copper to have afforded to the companies that have worked it any degree of prosperity. Of these are the South Cliff, Manhatten, North American, Boston & Northwestern, and other companies, all of whose operations have resulted unprofitably.

The same transverse veins which have proved so abundantly rich beneath the greenstone in crossing this belt, are poor and of a character in keeping with the country rock.

Still further to the south is another belt quite distinguishable in character, within which are several beds of amygdaloid exposed at the surface, but the working of which has proved equally unprofitable.

The ash bed, to the north of the bluff, is crossed by the fissure veins which have here also yielded, in the aggregate, a large amount of copper, but occurring in pockets and not in any degree of certainty or with the comparative richness or regularity pertaining to the ground underneath the greenstone when crossed by the fissure veins. Underlying the greenstone and in contact with it, occurs a belt of conglomerate which at some points is utterly barren of copper, at others becomes a mere slide, while at the Allouez and at the Conglomerate Mining Company's location it becomes a distinct workable deposit. The fissure veins crossing the greenstone have never proved sufficiently rich in copper, in this formation, to be profitably mined.

As before stated, immediately succeeding the final treaty extinguishing the possessory rights of the Chippewas to the lands in the Upper Peninsula in 1842, and the decision of the General Government to issue to applicants exploring permits, the country became at once flooded with searchers for mineral who made locations and obtained Government leases therefor which they subsequently sold to eastern capitalists.

A person by the name of Raymond secured, thus early, several of these leases, three of which he disposed of to parties in Pittsburg and Boston. These leases comprehended: First, three square miles including Copper Harbor—a name given to this point by the early *voyageurs* by reason of the cupriferous vein which conspicuously outcrops here; second, three miles square on the west side of Eagle River, in which tract is included the Cliff mine; and third, a like tract in the next township west. Work was begun by these Pittsburg and Boston gentlemen in 1844, consisting of sinking a shaft to the depth of forty feet, on Hog's Point, under the direction of Charles Avery, the president of the association. This was the first mining shaft that was sunk on the lake.

Soon after a continuation of this vein, with much more favorable indications, was discovered on the opposite side of the harbor near the site of old Fort Wilkins. This vein contained a deposit of black oxide of copper, a remarkable fact, since it has proved to have been the only similar deposit that has thus far been found, excepting, perhaps, traces of the same vein which has occasionally been observed elsewhere in this vicinity. The mining work was immediately transferred to this point, and two shafts were sunk at a distance apart of about 100 feet. The pocket of black oxide proved of brief duration; about 40 tons were obtained and sold for $4,500. The main shaft was carried down a distance of 120 feet and levels were driven each way from the shaft, in the vein, without finding any more of the ore.

THE CLIFF MINE.

In the meantime an important discovery was made on the Eagle River location by a party of explorers, under the direction of Mr. Cheny, in the greenstone bluff in the s. w. ¼ of sec. 36, T. 58 N., R. 32 W., being about three miles distant from the lake, which is what became known as the Cliff Mine. This celebrated vein was first discovered in 1845 on the upper surface of the greenstone, where it is narrow and gave little indication of the enormous wealth concealed below.

It was examined by Dr. Jackson and Mr. Whitney, geologists, who advised, as the vein became wider and richer as it was traced downward on the wall of the bluff, that it would be well to uncover and examine it at the foot. The rocks at the foot of the bluff were cleared away in the winter of 1845, and indications obtained which stimulated to increased activity. An adit was driven

a distance of about 70 feet, when it intersected a mass of copper—the first mass of native copper that had been found in place in the Lake Superior region. This discovery was one of the most important that has been made in the copper district, since it determined the fact that the erratic boulders which had been previously found had their origin in the region itself, and since it was but the precursor of a continued succession of masses that astonished the world and gave confidence to investments in the country and enthusiasm and zeal in its investigation.

After the discovery of the Cliff Mine the Eagle River location was purchased of the government and the other leases were abandoned. About the time the first work was done the gentlemen holding these leases entered into articles of agreement for the formation of a company; these parties were H. G. Hussey, T. M. Howe, and five others. The association was formed May 13, 1844, as the Pittsburg and Boston Mining Company, and under that name was incorporated by a special act of the Legislature of Michigan, approved March 18, 1848, with a capital stock of $150,000, divided into 6,000 shares. The number of shares were subsequently increased to 20,000, without any increase in the capital stock.

The cost of the lands purchased from the government—about 5,000 acres—was $11,600.

The Cliff vein, an amygdaloid trap, was from the start remarkably rich in mass copper, and subsequently also afforded a considerable amount of stamp rock obtained especially from the beds of amygdaloid, or the amygdaloid floors, which intersected the vein at right angles, having a varying thickness, and which were of frequent occurrence, and dipping and running with the formation, and some of which were found to be highly productive in copper. These amygdaloid beds are shown in the accompanying longitudinal section of the mine. They occasioned some trouble from the crumbling character of the rock, tending constantly to close up the shafts and the levels, making it frequently necessary to enlarge the shafts and lower the tramways in the levels. The rock did not crumble off in fragments to any great extent; it was hard and sufficiently difficult to mine, but the pushing force was stronger than any timbers were able to resist.

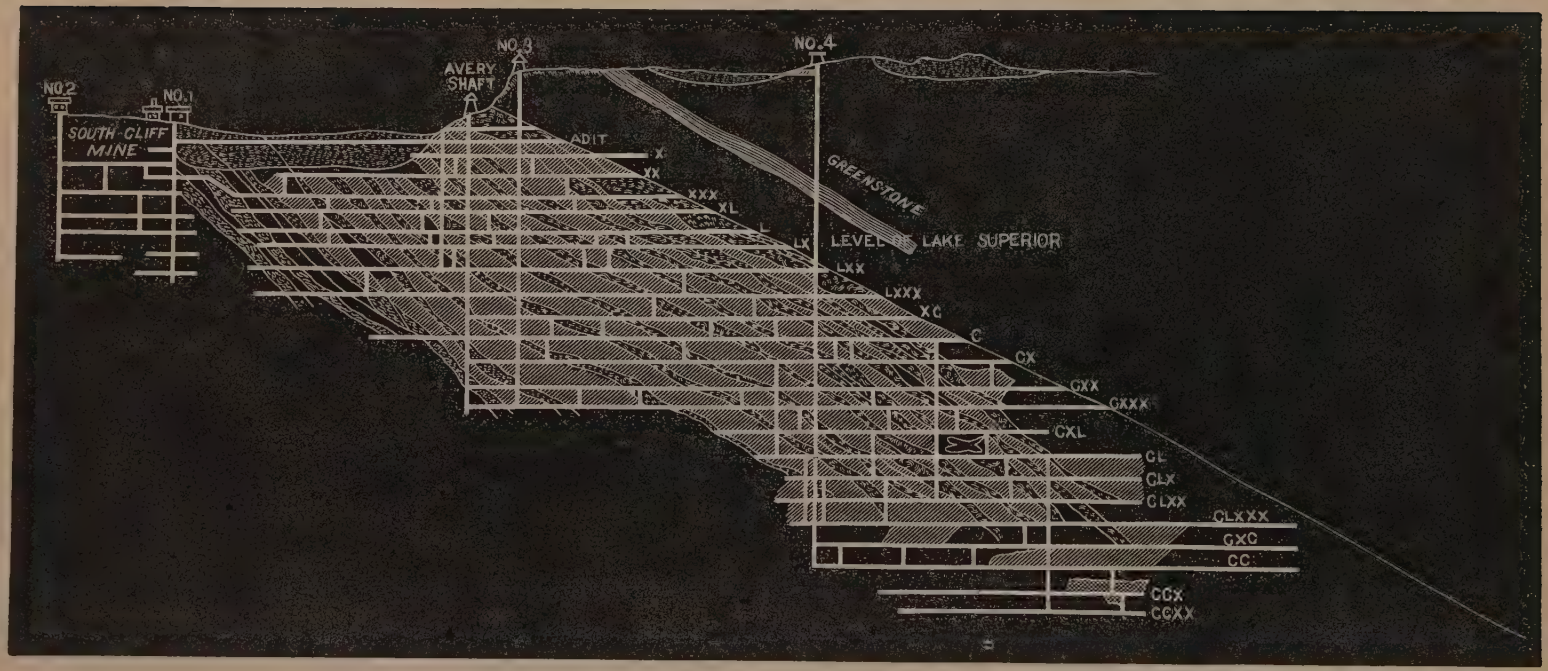
Work was fairly begun in 1846, and during the seven years thereafter the vein was penetrated to a depth of 462 feet and a range of about 1,200 feet, and sufficient copper taken out to realize in net sales the sum of $1,328,406 83. It may be safely asserted that nowhere in the world had there previously been produced so large an amount of copper from the same amount of ground. The mine was paying to the company a net profit of $20,000 per month.

The dividends paid during this period aggregated the sum of $462,000, or $77 per share, the first dividend, $60,000, being paid in 1849, and the total assessments had amounted to $18.50 per share, $110,000; at this time the stock and the quotations of the stock in the Boston market, June, 1854, was $175 per share.

To illustrate how little was definitely known regarding the geological structure of the country at this time, the opinion was entertained that the greenstone would, in itself, prove productive in copper. It was also thought to be possibly an overcap, or to compose a basin, and thus did not extend far into the earth, so that the lower levels, if extended northward, would pass under it. With a view to settle these conjectures, the upper levels were driven into this formation, but all the workings in this direction went to establish the fact that the veins in the greenstone do not carry copper in paying quantity, and

LONGITUDINAL SECTION OF THE CLIFF MINE, 1881.

Scale, 600 ft. to one inch.



the scientific supposition, previously made, became verified that the greenstone belongs to the regular geological strata of the country.

No. 1 shaft was sunk at the foot of the bluff, and the levels therefrom, carried to the north, intersected No. 3 shaft which was sunk vertically from near the edge of the bluff, passing 129 feet through the greenstone to the slide where it intersects No. 1 level; but as the mine attained depth and the levels were pushed to the north under the greenstone, the necessity began to be greatly felt for increased facilities for hoisting to the surface. The peculiar geological features of the mine, being overlaid with the heavy belt of crystalline trap, rendered it necessary that either a vertical shaft should be sunk, although it must pass through 650 feet of unproductive rock, exceedingly difficult to excavate, or an inclined shaft must be built running down into the mine following, substantially, the direction of the limiting greenstone wall. The objections to the latter arose from the irregular and tortuous course of the vein and the frequent enlargements from 10 ft., 15 ft., and even to 20 ft. in width, so that the necessary alignment could not be secured and keep within the vein; added to this was the fact that the ground had been very fully stoped out, in some places to an enormous width, which would render it extremely difficult to adequately support the track for a skip road. If the incline were made, it would require to be driven, mainly off the lode, to one side of it, in which case it would be all dead work—be driven in unproductive trap—and therefore it was thought to have little advantage in matter of economy of construction over the vertical shaft; in fact the matter was held under consideration for several years. The company's engineer carefully estimated the matter and it was concluded that the latter would involve the less cost. It was finally decided to sink the vertical shaft, and the work was begun in 1854 at a point 943 feet north from No. 3. This shaft, called No. 4, involved a nice problem of engineering, the work being carried upward and downward at the same time, and it being exceedingly important that the alignment should be exact. It will be readily understood that the carrying of a line down a deep shaft and thence for a long distance underground to be finally extended upwards hundreds of feet through solid rock to intersect an exact point, must require extreme accuracy to be successfully performed; in this instance the result was entirely satisfactory.

The mine yielded many large masses of copper at this time—1854. In driving north in the 7th level a mass was found 80 feet in length and 20 feet in breadth, so heavy that a sand blast of several kegs of powder did not suffice to stir it.

The company built a dock at the mouth of Eagle River and constructed a road from the mine thereto, warehouses, both at the mine and at the harbor, were built and many other surface improvements made, which included a 24-head stamp mill, to which 12 more heads were subsequently added.

The farm products in 1854 raised by the company were 30 tons of hay, 3,000 bushels of potatoes and turnips.

The total expenditures to the close of the year 1853 were $9,48,839.83. The average number of miners employed at this period was 120, and the average monthly earnings were $39 per month. Average cost of drifting in the levels was $30 per yard, and average cost for stoping per fathom $23. The company owned its own smelting furnace in Pittsburg, at which its mineral was smelted. About 70 per cent of the product was in masses, the remainder being about equally divided between barrel and stamp work. During its time there was nothing in mining history to compare with the surpassing richness of the Cliff. The Minesota approached it in productiveness, but scarcely

equaled it. For years there was scarcely a foot of ground that did not fully pay the cost for excavating, yielding in 1856 for each fathom of mineral ground broken the unprecedented amount of 1,851 pounds of mineral, yielding 67 per cent. refined copper.

The business of mining, especially for the more valuable metals, is at all times precarious and uncertain, but the owners were confident, and surely they found in their mine an abundant reason for the faith that was in them. During each year explorations were being made to discover additional workable deposits on the company's property, but without any conspicuous result. The number of men employed had increased to about 460 in 1856, at an average wage per month of $32. The mining work was generally done on contract. The cost per ton for hauling to Eagle River was $1 to $1.12.

The number of shares, in 1858 was increased to 20,000, and the market value of the shares was about $300 per share.

In this year the company set off a portion of its estate lying north of the greenstone to the lake and organized the North Cliff Mining Company. The amount of land ceded to this company comprised 1,000 acres, and a cash appropriation was also made to it of $50,000. The capital stock of this new organization was divided into 20,000 shares of $25 each.

In 1857–58 a new No. 1 shaft, denominated the Avery, was sunk vertically a few feet distant from the original shaft, and off the vein, to the 90 fathom level, and it was supplied with the necessary machinery for hoisting. This work was done to escape the constantly increasing difficulties and delays which characterized the working of the shafts sunk in the vein, which had become very perplexing. The Avery shaft was made of an increased size so as to admit of large skip buckets, and being furnished with improved machinery it greatly facilitated the working of the mine.

Heretofore there had been a large accumulation of waste rock which a want of facilities had prevented being hoisted and got rid of. This accumulation of rock naturally impeded the prosecution of work in the lower levels. The peculiar geological formation of the mine and the character of the vein were always formidable obstacles at the best, and began to be felt more and more as greater depth was attained together with increased extension to the northward. The copper being largely in great masses, a considerable force of men was continually employed in cutting them up, a slow and expensive operation, since no better method has been devised than the one early adopted, which consists in using chisels having a narrow face and of different lengths to answer for the increasing depth of the cut. One person holds the chisel and guides it along the line of cut, while a second man strikes with a sledge hammer. The mass is thus crossed and a chip equal in length to the width of the mass is removed. This operation is repeated until a complete separation is effected. The cost of cutting and removing was estimated to be $12 to $14 per superficial foot. The cutting up must be done in the level where the mass is found in order to reduce it to portions which the miners are capable of moving to the shafts with such appliances as may be brought into requisition.

As before stated nearly two-thirds of the product of the Cliff was in form of mass copper, and about one-half of the remainder in what is termed barrel work, which is simply the aggregate of all the smaller pieces, not exceeding usually a few pounds in weight. As most of the supplies are brought into the country from "below," the mining companies cause their imports, as far as may be, to be brought packed in barrels, and thus in turn these packages answer to contain the so-called barrel work of the mines.

In the days of the Cliff and of the great mines of that period stamp work had scarcely a tithe of the importance which it has since attained, and these early stamp mills were comparatively crude affairs. At that time it was found necessary to calcine the vein rock before passing it beneath the stamps. The object of calcining being to facilitate the breaking of the rock into small fragments, and was accomplished by piling it upon a layer of logs or of wood, which, on being fired, should create a sufficient degree of heat to disintegrate the rock without oxidizing the metal which it contained. This operation was usually performed in kilns—structures of stone or brick made for this purpose.

At the present time the process of calcining is little resorted to, the rock being prepared for the stamps by passing it through the Blake crushers, the large portions having been first shattered into fragments by being placed beneath heavy iron hammers (rock hammers they are called) worked by machinery.

The total current expenses of the Cliff mine for the first ten years were $517,108, and the total number of fathoms stoped during that period were 9,188, making the average cost per fathom to be $55½. The stoping cost about $4.72 per ton of rock. The tramming, burning, stamping and washing cost $1.30 per ton; superintendence and clerk hire 27 cents per ton; surface expenses and smelting, cost $1.29 per ton; estimated cost of opening the mine $1.29; pumping and hoisting, etc., $50; making the total current expense of vein matter per ton, from its position in the mine, through all its processes and manipulations till the product appeared in shape of ingot copper, between $10 and $11.

The same difficulties which had attended the working of the mine previous to the building of No. 4 shaft, and which had necessitated its construction, were again felt as the lower levels were extended to the northward under the greenstone, and led to the serious consideration of the question of sinking another shaft still further to the northward, or of carrying down an incline to reach the lower levels under the greenstone; but the immense expense which in either case would attend the carrying out of such an undertaking, caused the matter to be deferred and the work was never undertaken.

Up to 1858 there had been for several years but little variation in the annual production of the mine, and during these years it was at its maximum; thereafter some anxiety began to be felt and an appreciable falling off in the product was noticeable. Explorations to the south, after reaching a few hundred feet from the greenstone, did not develop any considerable amount of copper, and as greater depth was attained under the greenstone, a lack of the same degree of richness which had been experienced in the upper levels, was met with.

The working out of the amygdaloid floors, particularly No. 9, which latter "floor" was large and comparatively productive in stamp rock, together with the working up the stamp rock previously accumulated, contributed to keep up the yield of the mine; but for the first time in 12 consecutive years the company was unable to declare its accustomed dividend.

The shafts were provided with skips operated in guides in place of buckets, each skip holding about 2½ tons of rock. These were susceptible of much more rapid motion than could, with safety, be given to buckets. Ten skips per hour could be elevated from the 90 fathom level. The rock breaker, which has since come into general use in the mines, was first employed at the Cliff in 1860.

In 1860 the company purchased the estate, comprising 2,300 acres, together with the mining plant, etc., of the North American Mining Company, paying

therefor the sum of $100,100. This mine adjoined the Cliff, and had been worked extensively on two veins, but with poor success. Its pecuniary resources being exhausted the company was obliged to sell out, a good thing for them to do but proving a poor investment for the Cliff Company, since all their subsequent efforts in the way of explorations failed to develop anything of value.

The new North American—South Cliff it was called—was a mine opened in 1852 on the southerly prolongation of the Cliff vein, which at the time of the purchase was leased on tribute at a royalty of one-fifth of net proceeds. This arrangement was continued, the amount of royalty paid by the tributers averaging $15,000 per year.

In the early history of copper mining on Lake Superior it was generally held that in the true veins the deeper they were penetrated the richer would be the deposit; but the experience at the Cliff, Minesota and National mines seems to indicate that the lodes instead of increasing in richness with increased depth become, on the contrary, greatly impoverished. However this question may be settled with further experience, it is a fact that the Cliff mine attained a depth of 1,200 feet from the surface at the base of the bluff, and the area of the copper bearing ground had been gradually diminishing as the mine increased in depth, until from the many thousands of feet possessed nearer the surface it had dwindled to a few hundred, and the company regarding it as inexpedient to prosecute the openings to any greater depth, and having failed to discover any very promising ground elsewhere on the property, although continued explorations had been carried on, resolved that after July, 1870, further work should be discontinued and that the property be sold as soon as a purchaser could be found.

The estate at this time embraced about 11,435 acres of land, not including the 1,000 acres set off to the North Cliff and the 1,100 acres embraced in the American Mining Company's territory, The stock of the latter companies had been distributed pro rata to the stockholders of the Cliff.

The company was one of the pioneer companies of the region. As before stated it sunk the first mining shaft in 1844, at Copper Harbor, and afterward acquired at the Cliff mine the greatest degree of success heretofore experienced by any company, and while the stockholders were well compensated in dividends for their enterprise, their experience and success contributed greatly to aid and encourage others, and thus indirectly resulted in developing the material interests of the country. The whole amount of the capital stock paid in was $110,905, and from 1848 to the cessation of work in 1870 the Cliff mine had not only sustained the expenses of the company, but had paid to the stockholders the net sum of $2,627,660, or a little over 2,000 per cent. of the capital paid in. The capital stock paid in does not, however, represent the total expenditure incurred in bringing the mine to the dividend paying point; it sufficed to open the mine to the extent that the product met the expenses. Over half a million of dollars were expended before any dividends were paid. If it had not been for the excessive productiveness of this mine this preliminary expenditure would have been a failure. The wonderful success of this mine occasioned the starting of many others in similar situations, with apparently as reasonable prospects of success, but with perhaps the exception of the Central it has had no rival among the mines that have worked underneath the greenstone.

A considerable amount of land had been got under cultivation, producing annually several hundred tons of hay and oats, a large amount of potatoes and

other root crops. A flourishing village had grown up on the location, containing three churches, good school building, etc., with a population of about 1,500 people.

The action of the company in stopping was severely criticised by outside parties at the time, and it is still held by many that such action was unduly precipitate and not necessitated nor warranted by the product or condition of the mine.

But it seems to have been the policy of Dr. Hussey and the gentleman associated with him in the control of their several mining properties on Lake Superior, to take as few chances as possible. They put in sufficient money on the start to determine the fact, in their estimation, whether the mine was sure to pay or not, and to continue work so long as the mine remained self-supporting, but suspending operations before assessments were called for. Their object seems to have been to conduct mining as a legitimate business *per se*, and not to engage in it for the purpose of selling stocks. It is said of Mr. Charles Avery, who remained president of the company until his death, which occurred in 1858, that he never bought nor sold a share of stock in his life; and it may be safely stated of these gentlemen, Messrs. Avery, Hussey, Howe, Cooper, etc., that the management of affairs of the several mining companies which they controlled, have ever been conducted with a just view to the best interests of the stockholders, and to the advancement of legitimate mining enterprise.

Work was stopped in 1870, and in the following year the mine was sold for the sum of $100,000; from the sales of property and funds on hand, two dividends were made in 1871 of $100,000 each, leaving a balance in the treasury of $98,296.99. But this sum was reduced by losses and litigation to $38,620, which amount was finally divided in 1879, thus exhausting the entire assets of the old Pittsburg and Boston Company.

The mine was sold in 1871 to Marshall H. Simpson, of New York, for $100,000, including all the lands in Keweenaw county that the company owned except the North Cliff property and North American property, and in 1872 a reorganization was made, under the general mining laws of the State of Michigan, under the title of the Cliff Copper Company, with a capital stock of $500,000 in 20,000 shares. The mine has since been under the management of Mr. O. A. Farwell, an experienced mining man, who resumed work in April, 1872, the first 14 months thereafter being consumed in pumping the water out of the mine and in getting out some copper in the upper levels. During the first year after the new organization began work the product was wholly mass copper and barrel work. Numerous masses were found between the 150 and 180 levels and north of No. 4 shaft, in the portions opened by the old company in ground which had been left, supposed to be too poor to pay for stoping, but proved to be very rich, yielding frequent masses of 20, 30, 40, and 50 tons weight.

In 1872, 92 men were employed; in 1873, 250 men; in 1874, 225 men; in 1875, 112 men; in 1876, 106 men; in 1877, 100 men; since which time a smaller force has been worked, in 1878, 40 men; in 1879, 50 men.

The mine was lowered to the 220 level prior to 1876, the work being done north of No. 4 shaft. Between 180 and 190 levels a little copper was found, but from 190 to 210 levels the ground proved barren. During the past year the main portion of the product has been got in the 210 level, 1,200 to 1,400 feet north from No. 4 shaft. The company now employs 75 men.

The stamps have, since four years ago, until recently, remained idle, but during the present season they were again set to work, working part of the time, and stamping about 75 tons per day. The water is obtained from a dam in the Eagle river, 300 feet from the mill, and is conveyed away from the mill through a long launder. The mine has now been explored to a vertical depth of 1,800 feet from the surface at the top of the bluff, and the indications are not promising. The rock is hoisted from No. 4 shaft, and after being broken is trammed to the top of the bluff, a distance of 1,000 feet, and then dumped down a shute into cars at the bottom, and is thence trammed 200 feet to the mill. The stamps are the old Cornish pattern, 36 in number. The pumping is done through No. 1 shaft, directly beneath the bluff. The vein is exactly vertical.

The company own the old South Cliff mine, and also a part of North Cliff property, extending to the lake, and during the past year borings have been made with a diamond drill in the South Cliff, down to 266 feet in depth; the work was undertaken with the hope of finding copper bearing belts, but only trap was found. Since April last a party of men has been kept at work on the ash bed, north of the bluff. Two shafts have been sunk to a depth of fifty feet, and the developments are declared to be extraordinarily good—the ash bed showing an unusual width, and a more than average richness. Some of the rock has been brought to the stamp mill and worked up for trial. If the mine is opened, and work prosecuted to a large extent, a stamp mill will be built on the lake, and the mine probably opened with an adit. The accompanying section shows the workings of the old Cliff mine to date, and the vertical depth:

The following are the shipments, etc. In recent years a portion of the copper has been obtained from tribute working:

Years.	No. Pounds Mineral Produced.	No. of Pounds Refined Copper.	Yield Per Cent.	Average Price Per lb. Sold for, Less Cost of Smelting.	Value Realized from Sales.
1844	30 tons Bl. Oxide.				$4,500 00
1845	33,171	19,903	60	15c	2,968 70
1846	108,774	41,625	38.1		8,870 95
1847	729,848	410,783	56.3		70,937 32
1848	1,655,304	996,467	60.2		166,407 02
1849	2,285,050	1,282,127	56.1		155,227 04
1850	1,521,391	714,643	46.9		177,044 36
1851	1,528,465	846,486	55.3		174,931 96
1852	1,660,330	829,356	49.9		161,917 08
1853	2,253,182	1,071,288	47.33	27.32c	292,647 05
1854	2,332,614	1,315,308	56.35	24.38c	320,783 01
1855	2,995,837	1,874,197	62.56	25.33c	475,911 26
1856	3,291,239	2,220,934	67.48	24.12c	535,843 67
1857	3,363,557	2,363,860	70.28	20.44c	497,870 47
1858	3,183,085	2,331,963	71	21.03c	475,321 89
1859	2,199,632	1,415,007	64.35	20.50c	290,097 97
1860	2,805,442	1,843,393	65.70	18.93c	349,095 59
1861	3,103,641	1,928,011	62.13		401,223 73
1862	3,104,908	2,004,960	63.40		514,338 42
1863	3,010,539	2,100,354	69.76		694,944 12
1864	2,116,000	1,351,234	63.86	45.97c	626,302 50
1865	2,255,877	1,443,825	64	33.76c	562,000 00
1866	2,506,119	1,603,916	65.53	28.33c	469,472 00
1867	1,693,256	114,885	66.24	23.63c	268,000 00
1868	1,875,050	1,227,746	65.47	23c	285,054 00
1869	1,180,067	725,247		21c	154,973 00
1870	727,134	444,381			
1871		141,238			
1872		118,306			
1873	773,113	651,203	75½		
1874	1,398,879	1,052,901	73		
1875	1,649,341	1,162,873	73.41		
1876	988,884	908,146	76		
1877	234,220	161,319	74		
1878	316,687	414,415	74		
1879	206,672	134,336	75		
1880	122,378				

In 1861 the mine yielded $7,265.56 in silver; in 1862, $2,921.69; in 1863, $1,171.19.

The mine has yielded, as have all the Lake Superior copper mines, annually an appreciable amount of silver, from 25 to 50 pounds, in value from $1,500 to $5,300. In an early day a good deal of excitement was occasioned by the occurrence of silver, associated with the copper; but experience has shown that it cannot be depended on as a source of revenue. Its occurrence is similar to that of the copper, that is in a pure, unalloyed state. Bunches of native silver and copper are found intimately blended together, but never alloyed; sometimes the particles are so small that they cannot be separated, and the percentage being light, it is smelted with the copper. The silver which is saved separately is in the form of pieces of a few grains weight. It is understood that but a portion of the silver actually found finds its way into the coffers of the company; not unfrequently the miners regard such "finds" as their peculiar prize, and so appropriate it to themselves.

Officers of the Cliff are: M. H. Simpson, President; J. W. Blake, Secretary; office, No. 7½ Beacon street, Boston, Mass.; O. A. Farwell, Agent, Clifton, Mich.

NORTH CLIFF.

As previously noticed in the history of the Pittsburg and Boston Company, a company was organized in 1858 under the general mining laws of the State of Michigan, with a capital stock of $500,000, to work that portion of the estate lying north of the greenstone. One thousand acres of land and $50,000 in cash were donated to this new organization by the parent company. C. G. Hussey became the first president, and Thomas M. Howe the first secretary and treasurer, with the office in Pittsburg, Pa.

The purpose of this organization by the Pittsburg and Boston Company was to push forward more effectively and rapidly the development of the extensive landed property which the company possessed.

Mr. Samuel W. Hill, a gentleman very early and favorably known in connection with the Lake Superior copper interests, was employed to make a geological examination and exploration of the property, and his report to the company was sufficiently favorable to justify further examination and working. A consolidation was made in 1859 with the Swamscott Mining Company; the North Cliff property was conveyed to the Swamscott Company, and by a special act of the legislature the name was changed to North Cliff Mining Company. The same gentleman held the majority of the stock in both companies.

Mining work was regularly begun in the same year, and progressed until 1861, at which time the funds, with which the company had been endowed, were exhausted, and the general depressed condition of the affairs of the country, together with the fact that nothing very encouraging had thus far been developed by the mining operations, caused a temporary suspension of work. In 1863, stimulated by the rise of copper and the increased business activity, an assessment of fifty cents per share was made on the capital stock, and work was again begun under the direction of Mr. James Watson as superintendent.

The total mining work which was done comprised an open cut and adit 1,700 feet in length, which connects with the surface at the south end through an inclined shaft sunk in the ash bed. At a distance of 300 feet further to the south, No. 4 shaft was sunk 135 feet to the adit level; and 965 feet north of this was No. 3 shaft, which was down to the fourth level. Besides these three were two other short shafts, some winzes, drifts, and stopes, but the product was wanting; the result of all the work done was simply disappointment and pecuniary loss. It soon became evident that a paying mine was not likely to be had on the location, at least with such facilities as were then in vogue for separating the copper from its matrix, in the low percentage of rock which was obtained; all work was abandoned, and has never, until recently, been resumed. The fissure veins, like the old cliff, which proved so productive south of the bluff, have in no instance been found to be equally so when attempted north of the greenstone. The owners of the Cliff expressed a good deal of faith in the anticipated results from working the vein north of the greenstone, but unfortunately for their interests they failed to be realized. Since April, 1880, the Cliff Copper Company, who now own the property, or the portion of it north of the old Cliff mine, have been at work on the ash bed, as previously described, and have encouraging prospects.

NORTH AMERICAN MINING COMPANY.

Among the investments made by the Pittsburg and Boston Company, as before described, were the purchase of the property and franchises of the

North American, a company which was organized under a special charter from the State of Michigan, in 1848, with a capital stock of $300,000, divided into 6,000 shares. By successive amendments made in 1851 the charter was altered so as to increase the number of shares to 10,000, the capital stock remaining as before. The office was in Pittsburg, Pa. Thomas Bakewell, President; Waterman Palmer, Secretary and Treasurer.

The company held 2,400 acres of land, and the original mine was opened on the east ½ Sec. 2, T. 57, R. 32. A mine on this property had been opened in 1846 in a fissure vein under the south bluff of the greenstone. The vein has a bearing of north 58° west, and is thus not parallel with the Cliff and with other productive lodes. The vein is irregular and variable in width, and although it was worked to a depth of 415 feet it was nowhere found to be of a sufficiently favorable character to create very sanguine hopes of remunerative results. The lode seemed to be split up into three parts, and it was hoped that they would find the main lode into which all the branches united. The sum of $200,000 was expended on the location and in the mine by the company during the four years that they prosecuted work there, and the following amounts of copper were obtained: In 1849, 77,000 pounds; in 1850, 256,000 pounds; in 1851, 257,000 pounds; and in 1852, 77,000 pounds—yielding in the average 66.8 per cent of ingot, = 446,000 pounds refined copper.

A part of the company's estate comprised the N. E. ¼ sec. 1 adjoining the Cliff Mine on the south, which is crossed by the Cliff vein, and in 1852, the company having made explorations to determine this fact, transferred their mining operations to this place.

Here their efforts were at first attended with a success which imagination magnified into a hope of soon rivaling its northern neighbor, In the first level, only 40 feet below the surface of the rock, an immense amount of copper in masses was found, one of which weighed nearly 200 tons, being 40 ft. long and 20 ft. wide and 2 ft. thick. At this time this was the largest mass of copper that had been discovered on the lake, or in the world. In this stope, in the first level, 300 tons of copper were obtained. But the pleasing hopes raised by this temporary success were doomed to be eclipsed by the disappointing mists of subsequent failure. Sinking and drifting, however earnestly prosecuted, failed to develop another such deposit. The vein is covered heavily with drift. The first shaft passed through 10 feet of gravel and then through 42 feet of quicksand, when the rock was struck. A shaft was carried down into the rock 22 feet, and cross-cutting disclosed the vein 14 feet distant, carrying a width of 3½ feet. A pumping engine and a hoisting engine were put into operation. A considerable amount of agricultural products were raised, in value, in 1853, $3,500. As the levels were pushed to the south the ground grew poorer, until it became impossible to work the mine at a profit. In 1858 the company's affairs had reached a crisis, their funds were exhausted as was also their capital stock, and either productive ground must be found or the work must stop. It was thought of surrendering the charter and reorganizing under the general mining laws of the State, with a capital stock of $500,000, and of setting off a portion of the property and organizing another company and thus secure funds by selling the stock. Capt. W. E. Dickinson, the superintendent, advised that further working of the mine be discontinued. He claimed that it had been thoroughly cross-cutted and every reasonable effort made to find the original lodes, which he thought had been heaved or thrown at the slide, which occurs in the formation to the south of No. 1 shaft. He suggested that the mine be worked on tribute, without risk or cost to the company, and in the meantime such funds

as could be secured be expended in the direction of endeavoring to discover other and workable lodes on the property.

But the finances of the company prevented the adoption of any but that portion of the agent's recommendations which related to the letting of the mine on tribute, and work was thenceforward discontinued on company account.

The company had thus far expended during the period of its operations the sum of $733,805.15, of which amount $233,864 had been raised by assessments, $38,827 by sale of stock, and $426,988 by sales of copper produced, and the balance remaining as indebtedness. The underground workings in the South Cliff mine comprised 190 feet of sinking, and 230 feet of drifting, and the surface improvement included a large number of houses, three hoisting engines, shaft house, and 150 acres of land under cultivation, which produced excellent crops.

The sale of the property for $100,100 to the Pittsburg and Boston Company was made in 1860, and the proceeds were used in liquidating the company's debts. The managers of the old Cliff mine believed that the mineral vein, which had proved so enormously productive beneath the greenstone in their own mine, really traversed the extent of the North American property, and perhaps only required extensive exploration to discover it. It is difficult to realize, especially for those chiefly interested, that a vein which has held such great mineral richness at one point should become comparatively barren in the brief distance of 2,000 feet, which intervenes between the bluff and No. 3 shaft of the South Cliff mine.

The operations of the North American Company on this vein were limited to the first few hundred feet adjoining the Cliff; they had opened with encouraging success, and having apparently exhausted the deposit upon which they were working, were unable or unwilling to prosecute for further discoveries to the south. This task the Pittsburg and Boston were abundantly able to undertake, and immediately after the purchase a party of men were put to work to sink a shaft at a point 2,000 feet south of the previous workings. Lateral drifts were made in the expectation of cutting the lode at that point, but no favorable result was obtained. This country to the south is covered with a heavy drift, rendering the task of exploring perplexing and expensive work, and all the efforts in the direction of sinking, driving, and cross-cutting failed to reveal copper-bearing ground of much apparent value.

Mining experience on Lake Superior, as elsewhere, has shown that a vein does not generally prove equally productive throughout its extent—a change in the mineral composition of the inclosing rock, whether mechanical or chemical, is apt to be accompanied by a variation in the richness of the vein. Variations in the formation, perhaps sufficient to give to it a distinct character when arising from a change in its mineral composition, are not always apparent to the unaided eye or to the unskilled apprehension, and can perhaps be only determined by the trained expert, aided by the lens of a powerful microscope. At the Cliff the productive portion of the mine was found to be between the greenstone on the north and the slide—which will be seen marked on the section of that mine—on the south. At this point a distinct change is apparent in the mineral composition of the trap lying on the north and south side of the slide, but it was precisely here that a great diminution in the richness of the vein appeared.

The work done on the property by the Pittsburg and Boston Company was only in the way of exploration, and after a few years' trial was discontinued. At the time of the purchase the mine was let on tribute for a term of years,

and as stated in the history of the Pittsburg and Boston Company this work paid to the company about $15,000 per year.

After the sale of the Cliff mine all work here ceased, and the limited explorations with the diamond drill have equally failed of important results. These two mines of the old North American Company are now marked by a few ruinous shaft-houses and rotting buildings.

THE MEDORA MINING COMPANY.

The Medora is another one of the Keweenaw county mining properties that was controlled by the Pittsburg and Boston Company. The company was first organized under a special charter granted by the legislature of the State of Michigan in 1851. The property comprised 320 acres of land, being the E. ½ of Sec. 17, T. 58, N., R. 29 W.; situated immediately south of the Greenstone. Work was begun by the company, and prosecuted for a few years, but attended with poor success. The company having exhausted its available funds, and the stockholders failing to respond to further assessments, operations came to a rather premature close; the property and assets of the company passed into the hands of the Pittsburg and Boston Company. Nothing further was done until 1860, when the owners determined to further prove the mineral value of the property. With this view explorations were undertaken under the supervision of Mr. John Slawson, the agent of the Cliff mine. The mine had been opened on a fissure vein, and developed the existence of amygdaloid floors, similar to those observed at the Cliff, and Mr. Slawson's purpose was to ascertain the productive value of these. He sunk two shafts, east and west of the lode, at a distance apart of 47 feet, and connected them with a drift. He believed to have found paying ground, but the work was not followed up, and little further was done until 1864, when by some transfers of stock and a reorganization of the company, the sum of $20,000 was realized in available funds, and immediately expended in further work. An assessment of one dollar per share was made, to which but a portion of the stockholders responded, and the money being used up matters again came to a stand still. It was found that but little could be accomplished without the aid of a suitable stamp mill, the estimated cost of which, in that period of high prices, was $80,000, to which must also be added the additional sum of $40,000 for a working capital. The directors, admonished by their previous failures to raise money by assessment, did not hesitate to decline entertaining the project of the immediate erection of a stamp mill.

The total expenditures for mining, etc., amounted to the sum of $32,000. The officers were: Thomas M. Howe, President; James M. Cooper, Secretary and Treasurer. The property is said to be still owned by Dr. Hussey and his associates—men whose habitual caution prevented them from going beyond opening up the mine without thoroughly proving it. The houses and other buildings remain monuments of unavailing expenditure and labor.

PHŒNIX COPPER COMPANY.

Contemporary with the Pittsburg and Boston Mining Company, and really ante-dating it by a few months in the time of organization, was the old Lake Superior Copper Company, the progenitor of the present Phœnix Company. The originators of this pioneer enterprise, one of the most important ever undertaken on the lake, were among the first who proceeded to Lake Superior after the relinquishment of the Indian rights to this country in 1843. They

represented mainly gentlemen from Boston, who selected seven three-mile square locations, and afterward secured them by leases obtained from the War Department, and in 1844, February 22d, organized a company, dividing the capital stock into 1,200 shares of $100 each, 400 of which shares were assigned to the proprietors of the locations in payment for the lands conveyed to the company; these purchase shares were to be exempt from assessment. In addition to the 400 shares, the original holders of the leases were to receive compensation for the expenses incurred in locating the lands, etc., to be paid out of the first earnings of the company. The conditions on which these leases were granted by the government have been heretofore given, and were very advantageous to the lessees, as it gave them several years in which to explore the lands and to determine as far as they deemed requisite their mineral value before deciding to purchase; they were virtually long options, in which the government only secured to itself a percentage of the mineral products which should be removed.

The trustees of this early organization were David Hanshaw, Samuel Williams, of Boston; D. G. Jones, of Detroit, and Col. Chas. H. Gratiot; the latter recently from the lead mines of Missouri.

Several veins had been discovered on the property, and Dr. C. T. Jackson, who was employed to examine them, found them so favorable that he recommended the prosecution of mining work, which was begun October 22, 1844, in the east bank of the Eagle river, near the center of the line between sections 19 and 30, T. 58 N., R. 31 W. The preliminary work was directed by Dr. Jackson, but when he left the country late in the season, for his home in Boston, the charge of affairs was given over to Col. Gratiot, who had had previous experience in the lead mines. A brig, with supplies for the men, during the winter was lost on the lake, and the miners were consequently kept on very short rations; but Col. Gratiot, with fifteen men, managed to pull through till spring, when measures were taken to enlarge the operations. A stamp mill was decided upon, and the necessary machinery contracted for in Detroit, which, on completion, was transferred to the lake and got ready for work in August, 1845. This was the first attempt at a stamp mill on Lake Superior, but it proved unsuitable for the purpose intended, and was of little service. The building is yet standing in which this stamping work was thus early begun. But little mining was really done; the men were kept mainly at work putting up houses, stamp-mill, saw-mill, etc.; but the shafts had been sunk to a depth respectively of 75 feet, 30 feet, and 20 feet; the distance apart of the extreme shafts being 1,739 feet. An estimated product of 550 tons of mineral was taken out. An assessment was originally made of $35 per share on 800 shares, and it was supposed that this sum would be sufficient until the mine began to produce enough to meet the current expenses. The vein was traced in the bed of the river above the point where the openings were made, and showed a direction of N. 17° W., dipping slightly to the east.

During 1845–46 the work was prosecuted with considerable vigor, but the failure of the stamp mill was a serious drawback, and the extravagant yield which it was anticipated would be realized, based upon the analysis made by Dr. Jackson, failed to be realized. The main shaft was sunk on a pocket of copper and silver, which soon became exhausted, and efforts were made to recover the vein; with this view a tunnel was run under the river at a depth from the top of the shaft, of 90 feet. In the prosecution of this work beneath the bed of the river a crevice was discovered, which had apparently been at some time the bed of the stream, since it showed all the indications of the

action of water under such circumstances. This apparent bed was filled up with gravel and accumulations all showing the evident action of water, and in a deep hole made by the water, mingled with other accumulations, were discovered a considerable amount of native copper and silver; of the former, 18,000 pounds were taken out, while the silver was mostly appropriated by the miners, and it was thus never ascertained how much was found; one piece, however, weighing 8⅔ pounds—one of the largest ever yet discovered in the copper region, came into the possession of the company, and is now in the possession of the Philadelphia mint.

A further sinking to the depth of about 90 feet in the vein, which was found in this underground bed of the stream, completed the mining work of the company at this point. This was in 1846.

A good deal of dissatisfaction was felt with the agent, Mr. C. C. Douglass, who was discharged and Mr. Coryell appointed in his stead. The miners were also discharged on the suspicion of confiscating the silver found beneath the river. About 1,000 tons of rock had accumulated, and it was thought desirable to devise some way of working it up; accordingly a contract was made with a Mr. Taylor, of Detroit, for stamping machinery, but the managers, mindful of their previous failure, stipulated that if it did not do the work as recommended they were not to pay for it, and it failed to work. The agent began some work on a vein south of the greenstone, stimulated thereto by the great success of the Cliff.

The estate, which originally comprised about 40,000 acres, was reduced by the sale of 5,500 acres, the company obtaining therefor the sum of $33,000. Congress passed a law giving the lessees the opportunity of purchasing the lands which they held for $2.50 per acre, but the Lake Superior Company being out of funds concluded to renew their leases, as they had the option of doing on such lands as they desired to retain, for another three years.

In March, 1847 it was found that the total expenditures to date amounted to $98,790.50. The 800 assessable shares had been called upon to pay in $75 per share, and it began to be felt as a grievous burden; those holding these shares began to think that they had the worst end of the bargain.

Under these circumstances it was resolved to settle up the affairs of the company and sell out to a new organization. Accordingly arrangements were made by which the entire assets of the company were transferred to a new company organized for this purpose and chartered by the Legislature of Michigan, March 31, 1849, under the title of the Phœnix Copper Company. Its capital was limited to $300,000, divided into shares of $100 each. The incorporators were Joseph W. Ward, Richard Pitts, and Benjamin Graves. The charter was amended in 1851, making the shares $30 each. The board of directors was composed of A. W. Spencer, J. W. Ward, Mark Healey, B. W. Balch, all of Boston; Simon Mandlebaum, of Eagle River; A. W. Spencer, President; Horatio Bigelow, Secretary and Treasurer.

The old company had expended in all $105,833.40.

There were no less than five distinct veins at that time known to exist on the property, but practically very little was known as to their value, or as to how many other veins might exist. The five veins discovered were designated by the new company as the Phœnix, East Phœnix, Armstrong, Ward, and one south of the greenstone as the Robbins vein. These veins, with the exception of the last named, were all found in section 19, having a general direction of 12° to 17° N. W.

In the fall of 1850 work was renewed by the new company, under the supervision of Simon Mandlebaum as agent, at the mine.

No company on the lake has worked more persistently or had a more checkered career. Its stockholders, through a period of 30 years, have paid the frequent assessments and hoped in vain for dividends, which the management frequently declared they were just on the eve of paying. From the several mines on the property a great amount of copper, in the aggregate, has been obtained, and a vast expenditure has been incurred; but, with the exception of one small dividend, no return has ever been made to the stockholders. The estate is a very large one, and on it are found indications of copper occurring in every form of lode that exists in the country, and it is to be hoped that in some of these numerous veins or beds the company will yet find an abundance of metal that shall amply compensate for all the previous outlay and disappointment.

The mining work begun in the fall of 1850 was upon a vein which crosses the east line of the section, but not much was done, and in the spring of 1851 work was resumed in the old mine under Eagle river, and continued for two years. The vein proved too narrow to be profitably worked. The main shaft was sunk to the depth of 264 feet, and three levels were driven a length of nearly 600 feet. During this time some additional work was done on the new Phœnix, in the N. E. $\frac{1}{4}$ of the section (19). The first work done on this vein consisted in cleaning out some ancient pits, in one of which, at a depth of 10 feet, 1,200 pounds of copper were taken out; an adit was driven in the vein a distance of 900 feet, and a mass of copper weighing 2,390 pounds was found. The vein was found to be regular but narrow. The whole amount of copper shipped in 1851 was 13 tons, of about 60 per cent ingot. A record of the company's working shows that there was a constant changing from one point to another, first to one vein for awhile and then to another vein, or to some other point on the same vein. There was no persistent work done in any locality. Shafts were sunk 40 feet, 50 feet, or 75 feet, and a little drifting done and then abandoned; adits were almost indiscriminately started and carried forward 150 feet to 900 feet, and then the work given up on some pretext and a beginning made elsewhere. In 1853 the best outlook was in the old vein, south of the old workings, where it was found to be at that time 3 feet wide and showing well in copper, and the company expressed the hope that they would soon rival the Cliff.

In June of that year the charge of affairs was placed under the direction of Mr. S. W. Hill, with instructions to examine the tract geologically, and to report to the stockholders the most available points for mining. At this time the company owned 1,701 acres of land, chiefly lying north of the greenstone ridge. Mr. Hill recommended that the adit, started in the old vein, be continued until the ash bed should be intercepted, and that the shaft should be sunk further on the old Phœnix vein south of the greenstone, to determine the value of the lode in that position.

All the rocks of supposed igneous origin in this region are found to contain copper in the veins traversing them, and these veins are very numerous, but it has taken the expenditure of large sums of money to demonstrate the fact that too many of them were not rich enough to be sufficiently remunerative to pay the cost of production, particularly by the methods that have heretofore obtained. The body of the lands held by the Phœnix Company are admirably situated, having a gentle slope towards the lake, rising in the greatest altitude to about 550 feet, and having a soil adapted to the production of the leading products required

at a mining location. The Eagle river runs across the property, and at its mouth the company laid out the village, which afterwards was selected as the seat of Keweenaw county. From the sale of the lots the company realized a considerable profit. It became evident that the company were not likely to find on the north slope ground sufficiently productive in mass copper to be a main dependence for profit; the ground, so far as explored, indicated chiefly the occurrence of a low percentage of stamp rock.

The product for 1852 was 17,662 pounds of mineral in masses and barrel-work yielding 72 per cent ingot=12,651 pounds refined copper. In 1853 the product was 138,520 pounds mineral in masses and barrel-work yielding 64 per cent, = 91,737 pounds ingot. In 1854, 3,083 pounds, yielding 65 per cent ingot, and sold for $539.44. This shipment was sampled by Dr. C. T. Jackson, and assayed by Dr. A. A. Hayes, and found to contain $100 to the ton, of silver.

From this and other data the directors made a showing, that with their inefficient stamp mill, which had been repaired up and got to working, they could, with eight miners, turn out 2½ tons of mineral per month, yielding 80 per cent to 85 per cent of ingot copper, worth, at the mine, $500 per ton, =$1,250. The cost of production was estimated at $800 per month, thus leaving a profit of $540 per month. This estimate was put forward in contrast to the previous annual assessments of $20,000, for the encouragement of the stockholders, indicating what they might expect in the future. In addition to this it was stated that the lands under cultivation would yield an annual profit of $2,000, and the lots at Eagle river would bring $30,000 in addition to the $6,000 already received from such sales. Mr. O. A. Farwell, the president of the company, under instructions from the directors, visited the mine, and spent two months investigating matters in 1855, and it was under his superintendence that the old stamp mill of eight heads, built by the former company, was repaired up and set to work, and the mine, by the aid of an old engine, freed of water. Mr. Farwell decided to confine the work to the ash bed, and during the two following years it was continued, but instead of meeting expenses by the product, assessments were called for, amounting to $22,500. Additional stamps were added, making twelve in all. The directors determined, in 1858, to let the mine on tribute, and Mr. Farwell, the president, who was also acting as agent at the mine, was so instructed, but not being able to find parties to take it on a suitable lease the president continued work on company account. Two dollars and a half per share, additional assessment, was called for, and two of the directors visited the mine to investigate matters. This committee undertook to ascertain, by a continuous running of the stamp mill for a limited period, the yield of the ash bed, and the expense of obtaining the product. The intention was to find out, with the machinery then in use, whether it would pay to incur the heavy expenditure to put in greatly enlarged and improved machinery for the purpose of working this bed. But the committee did not succeed in making the tests to their satisfaction; they found many obstacles to contend with, and a project that seemed simple and feasible enough at home was found to be difficult to practically carry out at the mine, and they came away with the expressed opinion that the mine was undoubtedly valuable, and the ultimate success highly probable, but not perfectly sure. They estimated the profit of five months' work with 21 miners and a mining captain, running the stamps, 24 heads, 24 hours each day, for two months out of the five, to be $1,713.47. They found some gratification in the fact that the mine had increased in product from year to year since 1855, when work began

on the ash bed. In 1855 the yield was 10,847 pounds; in 1856, 25,445 pounds; in 1857, 39,351 pounds; and 1858, 65,800 pounds. The mining expenses for 1855 were $8,375.37; in 1856, $9,158.71; in 1857, $10,916.11; in 1858, $12,359.71; indicating that the ratio of the increase of product was greater than the increase of expenses.

The committee found that the mine could not be let on tribute on any fair terms; they had spent two years in opening the mine, and $22,000. The mine appeared to be rich enough to pay a profit for working, but had not been sufficiently tested to fully determine the fact. The conclusion reached was, that the better policy would be to continue to work a small force in as economical a way as possible, and not let the property pass into other hands.

The result of 10 days' trial with 12 heads of stamps, made in November, 1858, for the purpose of determining the yield of the ash bed and the profit to be derived from working it, was the production of 1½ tons of copper, estimated at 80 per cent. The speed attained by the stamps was 48 strokes per minute. The water power by which the stamps were run was found to be insufficient for the 24 heads to be run at that rate. If all the stamps were started at the same time it was found that two-thirds of them would have to be stopped, and they would be running only 8 heads after a few hours had elapsed. Steam power must be resorted to, they concluded. The committee also reported that they found, in examining the mining work which had been done on the location in previous years, the ground burrowed into with holes, numerous shafts and adits, but little evidence of persistent effort in any one locality, a great deal of scattering but not enough concentration, too many short shafts, shallow adits and limited drifts; with these the ground seemed to be honey-combed, and they were led to the melancholy reflection that possibly the much-enduring stockholder would have been spared a portion of the burden which was laid upon him in the matter of assessments if the past work had been concentrated upon one promising vein; at least they might have had the satisfaction of knowing whether that vein were rich enough to pay—a degree of knowledge which they did not then possess in regard to any vein on the location.

In the following year it was determined that the mining should be pushed forward with greatly increased vigor. Accordingly, as the primal requisite in working the ash bed, a new stamp-mill was built and 48 heads of Wagner's stamps were put in and a new engine procured of sufficient power to run 100 stamps—the heaviest engine at that time, it was claimed, on the lake. Other corresponding improvements were made, rendering necessary an assessment of $2.00 per share, which, with the others that followed, was promptly paid. The work on the ash bed was prosecuted exclusively for the three years succeeding, but was attended with no great measure of success, the yearly product varying from 20 tons to 35 tons of refined copper.

In 1863 mining was begun on the Phœnix and Robbins veins, south of the greenstone. Some previous work had from time to time been done in these veins to ascertain their value. The Central mine had recently opened on a fissure vein, similarly situated south of the greenstone, and was working very successfully, as had, for many years, the Cliff. The Phœnix decided to try its fortunes in this same locality. The old vein, south of the ridge, crosses the west line of the northeast ¼ of section 31, at a distance north from the ¼ post on the east side of about 1,100 feet, and had a bearing of N. 20° W., corresponding to the direction of the Cliff, Central, etc., which had proved to be productive veins. The further extension of the vein to the south was across the west

½ of section 32, owned by the Bay State Mining Company, which company also owned the south ½ of section 29, crossed by the east Phœnix vein.

The Eagle River is formed by two branches, one coming from the east and the other from the west along the foot of the south slope of the northerly range, which unite near the southeast corner of section 30, and runs thence, crossing the range, northwesterly to the lake. Through this opening made in the bluff by the stream runs the road from the south side to Eagle River, and it has been especially convenient to the Phœnix Company in the conduct of their mines on the opposite sides of the ridge. The frequent assessments which were made finally exhausted the capital stock, until, in order to secure further funds, it was concluded to make a new organization, thus creating a new capital stock on which demands could be made for the further prosecution of the work. And so in 1865 the old company was consigned to its grave and, Phœnix-like, arose from its ashes a new organization, full of zeal and the hope of success, but unfortunately doomed, as the sequel has shown, to a career more brilliant but thus far as unavailing to the stockholders as its predecessor. The ingot product in 1865 was 244,158 pounds, which sold at an average price of 29½c per pound net. The per cent of yield was 66. The product of the ash bed was dressed to a purity of 80 per cent.

Unfortunately for the revenues of the company the Phœnix vein pinched at a time when copper was at the highest market price, bringing 50c per pound. This narrowing of the vein occurred in the 30-fathom level, and continued pinched and barren, so that for the years 1866–'67–'68 the product for those years respectively ran down to 101 tons, 98 tons, and 130 tons ingot. But the vein again widened out and proved productive in large masses, yielding in 1869 nearly 400 tons of ingot, increasing in 1870 to 500 tons, and in the following year in an equal ratio. In these years were found the largest masses which the mine ever yielded, one of which weighed several hundred tons. It has been claimed to have been the largest mass ever found on the lake, and perhaps if all the portions which were attached together be considered, it was; but it lacked the compactness and boulder shape of the great Minesota mass, found a few years earlier. The number of tons of rock stamped in 1870 was 6,326, yielding 72½ pounds to the ton. In 1871 the mine yielded 1,758,629 pounds of mineral, which smelted gave 74.54 per cent ingot = 1,310,350 pounds refined copper, that sold for an average price of 23¾ cents per pound. The cost of mining, transporting, smelting, etc., was estimated at 15½ cents per pound ingot. The cost of the ingot per pound ready for shipment, including all items except interest on the indebtedness, was 19½ cents. The yield of copper per ton of rock stamped was 144 pounds.

The product from this and some adjacent mines was shipped at Eagle river, but a good deal of trouble was experienced, owing to the filling up of the channel with sand. The copper had to be taken from the dock in a scow to the vessel, which was obliged to lie outside. Great trouble was also experienced in hoisting the rock to the surface through the inadequacy of the hoisting power, and the increasing length of the levels to the northward under the greenstone. The matter of a new shaft, new machinery, and harbor improvement were seriously entertained by the officers of the company. The Bay State and Phœnix companies were mining on the same vein, which adjacent to the line of division of the properties had proven productive, masses of copper frequently occurring, lying on both sides of the line, naturally occasioning some dispute in the matter of division. A purchase had been for some time talked of, and was finally consummated in 1871, by which the Bay State property passed to the

ownership of the Phœnix Company. Some dissatisfaction was felt with the agent, and in 1872 he was removed, and Mr. Frank G. White appointed his successor, who found a much neglected condition of matters, large accumulations of waste rock in the mine, the machinery in bad condition, etc. Mr. White removed the stamps from the old Phœnix mill on the ash bed to the Bay State mill. The work on the ash bed had been for some time before discontinued. A combination of the two mills was thus effected, and resulted in a good one. The hoisting engine which was pronounced to be unserviceable by the previous agent was repaired up and found to be adequate to the present use. The work at this time, and for some time previously, was confined exclusively to this one vein. The company had entirely cleared off its indebtedness—for the first time. Its total assessment up to this date had been $817,500. In this year (1872) the long proposed inclined shaft was begun, inclining to the north at an angle of 38° with the horizon. The product for the year was 960,521 pounds of mineral, yielding 75 83-100 per cent ingot = 728,359 pounds refined copper, which sold at an average price of 34 71-100 cents per pound.

There was done, during the year, 304 feet of sinking, and 212 feet of cross-cutting. In 1873 the number of feet of sinking done was 952 feet, and of drifting 1,257 feet, and of fathoms stoping 920 feet. The product was 640,555 pounds of mineral, yielding 75½ per cent ingot = 521,081 pounds refined copper, which sold for an average price of 30 62-100 cents per pound. The results of this year showed no profit except what was accomplished in the way of improvements upon the surface and in the mine, costing $50,000. In this year a terrible explosion of dualine occurred at the mine, killing six men, among whom was Capt. John Hoatson, who was succeeded by Capt. Ed. Parnell, as mining captain.

In 1874 a better showing was made in the way of profit, although the work of improvement was continued at a large cost, yet $25,000 of surplus was accrued during the year. Unfortunately, work was again undertaken on the abandoned Robbin's vein—a leech that for several years thereafter absorbed a large portion of the earnings of the Phœnix mine. The inclined shaft was completed to the ninth level, a new engine and hoisting machinery procured, a new shaft house built and appliances added. The Robbins' vein, which had been previously opened to the fourth level, was pumped out, and the work of opening the fifth level was begun. The mine had been provided with a stamp mill, hoisting machinery, and other surface improvements sufficient for the purpose of working the vein.

The product for the year was 1,796,390 pounds of mineral, yielding 77 85-100 per cent ingot = 1,398,440 pounds refined copper, which sold at an average price of 22⅔ cents per pound. Twenty-six thousand dollars were expended on the work in sinking the inclined shaft. Measured vertically, the shaft passed down 750 feet, or 1,300 feet on the incline, from the surface before it came to ground that had not been worked out. In the tenth level a large mass of copper was found 1,200 feet south from the greenstone. The year's business showed a profit of $24,000.

In 1875 the product of the mine was 960 140-2000 tons of mineral, yielding 78 58-100 per cent pure metal, which sold for an average price of 22 5-100 cents per pound; and there were also obtained 4,732 ounces of silver. The profit for the year for the Phœnix mine was $75,000, $20,000 of which was expended on the Robbin's vein.

At the close of 1876 more ground was opened in the mine than there had been at any one time in its history, and the year's work gave a surplus of $107,186.00,

from which a dividend of $1.00 per share was paid, the first and only dividend the company has ever declared. The product, however, was smaller than was obtained the year before, being in 1876, 839 1060-2000 tons of mineral yielding 76 52-100 per cent, which sold for 20½ cents per pound. This falling off in the product was due to the pinching up of the vein that soon after widened out as the work progressed. The ground north of the incline shaft and below the 8th level did not yield any profit until the 11th level was reached, so that the diminished product of 1876 was duplicated in 1877, occasioning a falling off in the receipts of $90,000 as compared to the previous year; added to this was an expenditure for improvements amounting to $26,000.

The mine did not look promising, and although the work for the coming year seemed almost certain to result in loss, it seemed still more ruinous to stop. The only way was to push forward as the safest horn to the dilemma. The ground was poor and the vein had a tendency to pinch up. In addition to this, and in verification of the adage that troubles never come singly, the company met with a serious loss in the burning of their hoisting and pumping engine houses. They were rebuilt, and in a much more substantial manner than before. The Robbins vein yielded about 80 tons of mineral, mainly stamp work, obtained by selecting one ton from every four that were hoisted. The total mineral product for the year was 671 385-2000 tons, yielding 73 84-100 per cent ingot, which sold at an average of 18 44-100 cents per pound.

The surplus was reduced to $40,436.39, which was entirely obliterated the succeeding year, 1878, leaving at its close a deficiency of $3,870.91. The yield of the mine for this year was less than it had been for five years. The mining force was reduced and work at the Robbins mine was suspended. This vein has a bearing N. E., while the productive veins of the country bear N. about 20° W. The mine was well opened ahead in accordance with the general policy of the company in this respect. The product for the year was 336 1930-2000 tons of mineral, yielding 74 63-100 per cent ingot, that sold for 16 41-100 cents per pound. The ground in the 12th level, north of the inclined shaft, worked in 1878, was very poor, and has continued poor in the levels below. A noticeable feature, especially south of the incline, is that the ground above was broken and disturbed, the texture of the rock being soft and friable. It is a supposition that there is a connection between this disturbed condition and the poverty of the vein. When the rock becomes harder and resumes its normal condition there is a tendency to a return of productiveness. The inclined shaft, which started at the surface 120 feet east of the vein, is sometimes crossed by the tortuosities of the vein, so that it is first upon one side of it and then upon the other. Its cost has been about $200,000, and it is an open question whether it has not been a useless expenditure. All the hoisting from the mine is done in this shaft, passing into the rock-house which stands on the east side of the mouth of the shaft, where it is sorted and broken. From the breakers the rock passes down a shute into the cars, which tram it along the track laid on a trestle 400 feet southwesterly to the stamp mill, that stands adjacent to the highway. The stamp mill might be more advantageously placed under the bluff, directly east from the shaft and rock-house, thus saving the tramming and cost of trestle, and be equally accessible to water. Its present position is due to the desire to utilize the old Bay State building. By being placed in the position indicated the shute which takes the rock into the cars would have carried it directly into the stamp mill.

The water for the mill is obtained from a pond made by damming the Eagle

river, and is brought in a launder one-half mile to the mill; a second dam across the stream forms a pond near the mill, from which the water is pumped when it is required.

The company now own 2,477 acres, the mineral land being in sections 19, 20, 29, and 30; the situation of the mine now worked being, as before mentioned, in the S. E. ¼ Sec. 30, and in 29; the old original mine being in the S. E. ¼ Sec. 19.

The product for 1880 was 2,971,450 pounds to the close of navigation, yielding 76.5 per cent ingot. The cost of stamping and washing is about 75 cents per ton of rock; the cost for breaking and tramming is 20 cents per ton. The product of this mine is about one-half mass and barrel work, and one-half stamp copper. The number of men employed is about 125, of whom 65 are miners.

The tendency of the vein towards possible exhaustion rendering it desirable that some more profitable ground be opened elsewhere, together with the great encouragement lately given by the recent workings of this or similar formations by other companies, have induced the Phœnix to resort again to its old ground on the ash bed, where for so many years it burrowed in vain. Here they are driving up an adit to the south to intersect an old shaft at the second level, 150 feet below the surface; the mouth of the adit is 90 feet above the lake, and is distant from the shaft 2,300 feet, and from the lake one-half mile. They are also driving east and west in the ash bed from the adit, and it is said to be showing a remarkable width. About 1,500 tons of the rock were hauled to the stamp mill and treated for the purpose of a trial. It gave a little upwards of one per cent refined copper. A stamp mill will be built on the north side for the use of this mine.

Mr. M. A. Delano, the efficient agent, has been in charge of the company's affairs at the mines during the past six years, having succeeded Mr. White in that office. The eastern business office is in Boston, No. 8 Olive street; Wm. P. Hunt, President; Wm. C. Coffin, Secretary.

NORTHWESTERN MINING COMPANY.

Among the parcels of lands sold by the old Lake Superior Company, and which became at an early period the seat of mining enterprises, was the location of the Northwestern. The estate comprised a tract of 1,600 acres of contiguous land, situated on sections 24, 25, 26, 35, 36, T. 58 N., R. 31 W., the mine being opened on the west ½ of section 24. The proprietors were Messrs. Howe, Hussey, Cooper, and Moorhead, of Pittsburg, and H. N. Walker, of Detroit—the same gentlemen who controlled the Pittsburg and Boston Company,—and the local affairs of the mine were directed by Mr. Slawson, the superintendent of the Cliff mine. Work was begun here in 1845 on a fissure vein south of the greenstone, bearing N. 23° W., and dipping slightly to the west. The copper was disseminated through the vein stone, and occurred in shutes and in bunches, and continued in a small way for two years. The vein was opened about the same time on the north side of the range by the Copper Falls Company. On the surface it did not present a very favorable appearance, and no great confidence was entertained regarding it, but as greater depth was attained a good degree of width was found, ranging from one foot to four feet, averaging about one and one-half feet, subsequently widening to three feet, and also showing a sufficient amount of copper to excite a reasonable hope of future profits. The company, which had been originally organized in 1845 as the Northwestern Mining Company, was in 1848 reorganized as the North-

western Mining Company, of Detroit, with a capital stock of $300,000, with office in Pittsburg. From this time the work at the mine was prosecuted with considerable vigor; a force of 60 miners was employed; an adit was driven in from the south 1,250 feet to the greenstone, and four shafts were lowered that attained a depth in four years of from 60 feet for the shallowest, to 215 feet for the deepest. A stamp mill with 12 heads, erected in 1852, was put in operation, supplied with water for washing purposes, pumped from the mine and from the small branch of the Eagle river. A hoisting engine with winding machinery was erected at No. 4, the most northerly shaft. The stamp mill engine had an estimated power of 24 heads, with a surplus for a saw-mill, which latter also was built and in operation in 1853, much to the convenience of the neighboring mines. An engine of sufficient power, with a lift of pumps was procured the same year at a cost of $6,000.

The policy of the company was to open the mine to a sufficient extent to determine its probable value, and with this view the levels were well extended, but while some small masses were found, sufficient to give encouragement, the product amounted to little as a whole, being only, up to October, 1852, at which date the first shipment was made, 16 barrels of mineral, weighing 10,568 pounds, and four masses, too large for barrel work, weighing 3,268 pounds, = 13,836 pounds in all, from which was smelted 8,622 pounds of refined copper, selling for 23 cents per pound delivered at Cleveland.

In 1853, the mining force was increased to 80 men, and the product for the year was 61,165 pounds of mineral, which yielded in smelting 72.2 per cent = 44,166 pounds of refined copper.

In 1854 the product of the mine was 139 barrels of stamp copper = 77,375 pounds; 96 barrels of barrel rock = 43,594 pounds; 99 masses = 129,794 pounds; total of mineral, 250,763 pounds. This copper when smelted produced 9,584 ingots, weighing 154,900 pounds, and sold for $39,206.68 = 25¼ cents per pound. The charges for freight, smelting, labor, cartage, and insurance were 10 per cent on the net products. The masses averaged about 1,300 pounds each in weight.

The buildings and machinery were estimated at $26,475; 1,776 bushels of potatoes were raised on the farm in that year, 400 bushels of turnips and 20 tons of hay, and a large amount of lumber—several hundred thousand feet—produced. The average number of men employed about the mine was 100, the miners receiving $27.50 per month clear, and the others an average price $18 per month. The indebtedness was $16,500. The directors make no predictions for the future. Four additional stamps were put in the mill, making 16 heads in operation, and several houses built, making 24 in all on the location.

But the mine could not be made to meet the expenses, and the stockholders were yearly called upon for assessments, a demand which the Pittsburg and Boston men submitted to with very ill grace. So that in 1857, following the great financial revulsion, the company suspended work, having expended $218,000, $168,000 of which were paid in assessments. In the meantime the Central mine on the E. ½ of sec. 23, adjoining the Northwestern on the west, and working on a similar fissure vein, was meeting with great success; and stimulated by this fact, as well as the prevailing high price which copper bore in the market, a resumption of mining work was determined on in 1863. An assessment amounting to $60,000 was, made and operations were renewed, at first conducted with the view to discover the Central vein on the Northwestern property, since the company owned the land for a mile immediately south of

the Central. A shaft was sunk at a point on the course of the Central lode at a point 70 feet to the south of the south line of the Central property and about 800 feet south of the south level of the drift in the Central mine. The shaft, after passing through 45 feet of quicksand, intercepted a belt of hard, dry, chloritic rock. After cross-cutting in the rock, east and west 126 feet, to a depth of 12 feet, the vein was found, being distant east from the shaft 78 feet; but upon examination it was not found to carry copper in sufficient amount to encourage working. Other explorations had been undertaken and carried forward in the meantime, resulting in the discovery of what was deemed a promising vein, being about 100 feet to the west of the old Northwestern mine. It was thought to be the best way to prove this vein by cross-cutting from the old mine; accordingly the pumps were started and the old mine was freed from water, and the effort begun to determine the relation of the new vein with the one formerly worked. This exploration, however, was not thoroughly consummated. It was, in fact, but fairly commenced when the $60,000 which had been called in had been expended. A good deal of discouragement was also felt over the failure of the work to the south on the Central vein. So that there was but little disposition to go on any further, by a renewal of assessments, in a work that afforded as yet only uncertainty. The company had thus far expended $228,000 of its capital stock, leaving only $72,000 that could be called in to exhaust the amount authorized by the charter. Under these considerations it was concluded to suspend, which occurred in January, 1865.

The total expenditures of the company to that date aggregated $308,759.74, of which, as above given, $228,000 were got by assessment, and the remainder, a little upwards of $75,000, derived from the sales of copper. There was a small amount of copper,—6,651 pounds mineral, yielding 2,161 pounds ingot —obtained in 1864.

The total workings in the old mine comprise four shafts of a depth, respectively, numbering from the south to north: No. 1, 109 feet; No. 2, 201 feet; No. 3, 215 feet; No. 4, 225 feet; an adit level, 1,226 feet long; No. 10 level, 994 feet long; 20 level, 1,057 feet long; 30 level, 124 feet, with a number of winzes and several cross cuts. But a small amount of stoping was done in proportion to the ground opened; several thousand fathoms were left unbroken.

The same officers and board of directors were continued from the organization of the company: J. K. Morehead, President, and James M. Cooper, Secretary and Treasurer. The location is marked at the present day by the ruined buildings and shaft houses,—the natural result of years of neglect.

COPPER FALLS MINING COMPANY.

Cotemporary with the Northwestern, and working originally on the same vein, was the Copper Falls mine. The vein takes its name from the falls in the creek, in the bed of which stream it was first discovered. From the top of the falls to the bed of the stream below, the vein was observed to double in width, becoming from a foot to 18 inches wide, and lumps of copper were found in the stream below the falls, and a little digging and blasting, which was done, revealed a considerable amount of copper. An adit was driven in on this vein, and four shafts were sunk in it. The proprietors were filled with the most sanguine hopes of success, for in many parts the vein appeared exceedingly rich in small masses and pieces of copper, and in one instance a mass weighing seven tons was found at a distance from the surface of 50 feet; this was in 1846, and at the time was the largest mass that had been found on

the lake. Considerable silver also was found in this vein, both in a pure metallic state and also in some of its combined forms, more than a ton of which ore was sent to Paris for examination and sale. This vein was somewhat irregular, being barren in some places and, as before said, yielding abundantly in others, and it was hoped that as greater depth should be attained the vein would prove uniform and rich; with this hope the work was prosecuted vigorously, for that early day, during two years. During this time the four shafts reached a depth, commencing with the most northerly one and going south, of respectively 47 feet, 208 feet, 45 feet, and 83 feet, and the adit had been driven in a distance of 265 feet, and a winze had been sunk 66 feet below the adit level; all of these shafts were connected with levels at suitable distances. A good road had been built to Eagle Harbor, which was distant from the mine two and one-half miles. Some dwelling houses had been built, and mining plant secured. At this time it was found that the workings had been carried on in a bed of trap, between two beds of sandstone. The vein bore well in the trap, but was barren and split up in the underlying bed of sandstone, down through which the work was continued. To ascertain whether the vein would again be found productive in the trap underlying the sandstone, a shaft was lowered 40 feet through it, and some cross-cutting done to recover the vein, but without success,—doubtless for the reason the cross-cuts were made too near the juncture of the beds where greater disorder would naturally exist. The vein was subsequently found on the surface, crossing this underlying bed.

This work was done under the auspices of an association formed October 16, 1845, and known as the Copper Falls Company, who purchased of the Lake Superior Company, government lease No. 9, paying therefor the sum of $11,060.97. The lease had been granted to David Henshaw by the War Department, and embraced 4,261.5 acres of land, comprising sections 11, 12, 13, 14, 15, and fractional sections 1, 2, 3, 10, T. 58, N., R. 31 W., being bounded on the north by the lake, on the east by the Eagle Harbor property, on the west by the Lake Superior Company's land, and on the south by the Dana, Winthrop and Northwestern Companies' lands; on the south line the lands rise to an elevation of about 700 feet above the lake. The mining work done by this association was mainly confined to the vein, as above described, on section 11, and the expenditure incurred amounted to $100,000, $40,000 of which had been drawn from assessments, and $15,000 derived from the sales of the copper which the mine had produced, and from sales of stock. In 1848 a special charter was obtained from the State of Michigan by the association, and for its benefit, the shareholders being designated as the incorporators under the act, giving to each one as many votes in the new company as he held shares, and by vote of the stockholders the stock,—1,000 shares of $30 each—was issued share for share to the members of the old associations upon surrender of the old certificates and payment of dues. The new organization was designated as the Copper Falls Mining Company, and to it was transferred all the assets, real and personal, of the former association. In the following May the lands, which up to this time had been held only on lease, were entered at the government land office, and a patent for them obtained. In July thereafter an amendment to the charter was granted by the legislature, increasing the number of shares to 10,000. The former certificates of stock were called in, and new ones, of proportional amounts, were issued to the shareholders in accordance with the increase in number.

John T. Heard was chosen president, and Horatio Bigelow, secretary—office in Boston. Work was continued in the old mine until the summer of 1850,

but not having proved profitable, and the mine not appearing favorable for a continuance, the agent was directed to discharge his force and to suspend work.

A short time previous, however, some work had been done in continuance of what had been begun in 1847 by the former company, on a vein lying 40 rods to the east of the one principally worked. In this vein a shaft had been previously sunk, and it was decided to drive an adit to intersect it. This adit was driven in the fall of 1849 a distance of 250 feet, mainly in dirt and decomposed rock, until within 30 feet of the shaft, when the rock became compact and the vein well defined, with a width of 18 inches, carrying considerable copper. The adit completed, a cross-cut was made to the southwest from the shaft 80 feet, but, as before stated, the outlook was not sufficiently favorable under the existing financial condition of the company, to warrant a continuance, and so matters were brought to a stand still.

In driving the adit and cross-cut it was expected to arrive south of the sandstone; on the contrary the end of the work proved to be to the north of it. Under these discouraging circumstances the directors concluded that it would be well to know something more of the location geologically. Accordingly, soon after Mr. Samuel W. Hill, who had recently been connected with the geological survey of the Lake Superior region, was employed to made a thorough examination of the property and determine as near as possible the most suitable point at which to resume mining.

Mr. Hill determined the existence of six distinct transverse veins, designated as the Jacobs Creek vein, the Hill vein, Copper Falls vein, old Copper Falls vein, Child vein, vein No. 3—the latter the most easterly one—and subsequently a longitudinal lode which he named as the ash bed, from its volcanic, scoriaceous, ashy character. These several veins are nearly parallel with each other, being about N. 22° W.

In June, 1851, Mr. Hill was engaged as superintendent, and under his direction the work of opening a mine was commenced, in accordance with the recommendation which he had previously made, on the Copper Falls vein, situated about a half of a mile to the west of the old mine. Here a new location had to be made, the land cleared, some houses erected, shops, office, etc.

A year later work was begun on the Hill vein, to the west, intending to connect the two mines where opened by galleries driven across in the ash bed.

The Copper Falls mine was opened with an adit 2,350 feet in length and with seven shafts.

The Hill mine was opened upon a much more extensive scale, exceeding anything previously attempted on the lake. A deep adit was started from a point in the vein 50 feet above the lake and driven in the vein, to be connected with the surface by seven shafts, No. 1 being 2,320 feet from the mouth and No. 7 6,400 feet, at which point, when completed, it would be 700 feet below the surface. In the prosecution of this work the discovery of the so-called ash bed was made. This important metalliferous deposit is included in the formation similarly with the metalliferous beds found in Houghton and Ontonagon counties, and underlies a fissure vein running east and west along the plane of contact. The discovery of this bed was due to the extensive ancient workings, which were found to mark the surface outcrop for a great distance. Some of these near the Copper Falls mine, on being opened, proved to be 70 feet in length and 37 feet in depth. So greatly did they exceed in dimensions any works of this character which had been previously observed in this district that their artificial origin was not at first suspected. But the heaps of earth and of rocks which had been thrown out, and the stone hammers and copper arrow-heads

and the bits of charcoal and rotten wood and the other evidences which, upon examination, were found in the bottom of these pits, determined their nature. The mine on the Hill vein had been started on a plan of such magnitude that it was deemed best to secure the possession of its southerly extension; accordingly the adjoining one-fourth section of land to the south, to wit: The N. W. ¼, Sec. 23, was purchased for the sum of $8,000, thus making the estate 4,421.5 acres. The company endeavored to arrive at as clear a knowledge as possible of the mineral value of the property—of the character and productive capacity of the veins. Feeling assured of remunerative results the directors planned to operate on an extensive scale. Up to the close of 1853 there had been expended about $220,000, $180,000 of which had been derived from assessments. Up to March 1, 1852, the total cost at the two mines for labor was $17,924.87. The average net wages paid to miners, exclusive of board and other fees, was $37.35.

From March 1, 1852, to March 1, 1853, the total mining expenses for sinking, drifting, etc., were $32,912.37, and for a corresponding period to March, 1854, they amounted to $40,784.28; for that year the average number of miners employed was 65, who received average net wages of $34.58 per month. The surface expenses during the corresponding previous year were $35,066.09, and the average number of surface hands employed was 69. The cost of sinking per foot, including all expenses at mine, was $14.04; drifting per foot, $5.44; and stoping per fathom, $14.26.

The product for 1852 was 17,662 pounds mineral, yielding 72 per cent ingot = 12,651 pounds refined copper, and the product for 1853 was 138,520 pounds mineral, yielding 64 per cent = 91,737 pounds ingot.

The surface improvements made during the year comprised four and one-half miles of graded wagon road to Eagle Harbor, to which work several of the adjoining companies contributed, 27 dwelling houses, two boarding houses, office, shops, engine house, boiler house, a stamp mill, a saw-mill, etc. The stamp mill contained 24 heads of stamp, with an engine of sufficient power to drive 48 heads.

The mines were opened with the view to secure drainage through the adits. In the Hill mine four adits were started, the lowest being at the seventh level; and in the Copper Falls mine there were two adits, the lowest at the fourth level.

The agent, at first, expected to realize a considerable yield of mass copper, as well as, if extensively opened, an almost unlimited amount of stamp rock. During the summer of 1854 a force of 24 men was engaged in stoping, and 80 men were employed in extending the drifts and shafts. It was found that very little mass copper was obtained, while much more stamp rock was produced than there were means of working up.

There were opened about 11,000 fathoms of ground for stoping, of which nearly one-half was considered as worth removing, much more than would be needed with the facility then possessed, for some time to come. The agent recommended that the number of stamps be immediately increased to 64 heads; in fact, he gave it as his opinion that 100 heads were needed, and that with this number the mines could be profitably worked. He thought it would be settled that the future of the mine would depend on working the stamp rock. The occurrence of mass copper could not be expected in sufficient quantity to afford a large amount of income. The ash bed rock he considered could be stamped and washed for from 40 cents to 50 cents per ton, yielding

one per cent of ingot; and if only enough were mined and worked up a sufficient profit would be assured.

The full extent of the recommendations of the agent were not adopted by the directors; a medium course was chosen. The number of stamps was doubled, making the number 48, and improved washing apparatus was introduced; but owing to the failure in getting the materials on the ground before the close of navigation the completion of these improvements was not brought about until the summer of 1855. It was also decided to stop the further extension of the mine, and to reduce the labor and expenses as far as possible. Mr. Hill was succeeded by Wm. Petherick, as agent of the mine. The stamp rock was found to be exceedingly variable, yielding from nothing to 1,000 pounds, and even as high as 2,000 pounds per fathom, and it was estimated that from 80 pounds to 100 pounds per fathom would cover expense.

The total mining expenses for 1854 were $50,260.43, and the total surface expenses for 1854 were $44,843.62. The cost of drifting 4,157 feet was $5.61 per foot; for sinking 821 feet was $14.85 per foot; for stoping 1,000 fathoms was $14.73 per fathom. The average number of miners employed was 96; number reduced at close of the year to 62. The average net wages for miners was $34.63 per month. The average number of surface men and other employés was 112, and the average wages received per month was $25.89 clear of board and doctor's fees. Total expenditures for the year were $238,152.55. The product was 258,876 pounds, yielding 55¾ per cent = 144,269 pounds ingot. Some preliminary work performed during the year on the Owl Creek vein developed an apparent productiveness, which appeared highly encouraging, and which subsequent operations proved to have been not at all misleading. The mining work on company account came gradually to be confined to this vein and to the ash bed, and the Hill mine and Copper Falls mine were let on tribute.

In 1855 the capital stock of the company having become nearly or quite exhausted by assessments, the company was reorganized with a capital stock of $500,000 in 20,000 shares.

The product of the mines in 1855 was 282,733 pounds mineral, yielding 60 per cent ingot. The annual product continued to increase from year to year, and in 1859 it had become double the previous year's yield; the expenses had also somewhat diminished, so that the outlook for the future became more encouraging. This favorable result was due to the company's increased facilities for manipulating the vein rock, although the yield was only 1 1-10 per cent. The average cost per ton of rock for mining, raising, tramming, breaking, stamping, washing, etc., was $3.64, and the average yield per ton was, for three years, 21.7 pounds, and the average price received was 22.2 cents per pound. An accurate account of the work was kept for a period of three years and eight months, for the purpose of ascertaining the profit of working the ash bed, resulting in the averages above given. The results for each year were:

	Ton of Rock Stamped.	Pounds of Copper Produced.	Copper per ton of Rock.	Average Sale per Pound.
8 Months, 1858	6,217	126,369	20.3	0.23.40
1 Year, 1859	15,850	372,985	23.5	0.22.12
" 1860	15,590	399,877	20.4	0.21
" 1861	24,068	486,108	20.5	0.23

In 1861 the company set off 1,200 acres of its estate—adjacent on the west—so described as to include the Copper Falls and Hill mines, to a new company which it organized—the Petherick. On these mines the sum of $300,000 had been expended, and the Copper Falls Company received for the property 10 per cent of this amount.

The company has ever manifested a liberal and progressive spirit, disposed to keep up with the times by introducing such new machinery and improvements as had been proved to be advantageous, and to incur its share of the labor and expense of testing new machinery and new methods; in 1861 one head of Ball's stamp was introduced into the stamp house, and was found to work very satisfactorily. From 1858 to 1861 $60,000 in assessments were called in, and in the same time the sum of $86,173.23 was expended in surface improvements and machinery.

The cost of the mine to December 31, 1862, was $960,000, but there was a profit on the year's work (1861) of $30,000.

In 1862 there were stamped 19,752 tons of rock, which yielded 20 3-10 pounds of copper to the ton, or 339 pounds per cubic fathom of ground stoped, being an increase of 62 per cent over the yield of the preceding year. Two heads of Ball's stamps were in use, and the cost per ton for stamping, washing, and for barrels, materials, labor, repairs of machinery, etc., was $1.12 per ton. The total number of tons taken from the mine was 21,345, and total number cubic fathoms stoped was 1,181. Number of pounds of mineral produced was 468,624, which yielded 85 per cent. The average mining force employed was 78 men; in all, 102 men.

It was found that there had been a fraudulent over-issue and sale of stock amounting to 3,700 shares, which were bought up and cancelled by the new board of directors, and the number of shares made to conform to the requirements of the law.

In 1865, in sinking from the adit, which was 1,500 feet in length, to the levels below in the Owl Creek mine, to secure ventilation, a fissure vein was discovered, which proved very rich in copper, and greatly augmented the output, which became, in 1866, 538 1109-2000 tons of ingot, and in 1867, 1,128 1485-2000 tons ingot. In this year the company was able to pay its first dividend. The Owl Creek is the only mine north of the greenstone that has ever paid any dividends.

This greatly increased product, which began in 1865, was due to the discovery of a magnificent deposit of masses, which occurred in the 40th, 60th, 70th, and 80th levels in a compact space; in all, obtained about 4,000 tons. In the 90th level the masses ceased to occur. In 1873 and 1874 the mining was done in rich ground, and the product was consequently large. In the latter year its reported assets were $99,045.17, and its liabilities were $48,046.29, leaving a surplus of $50,198.39. A terrible accident occurred, occasioning the death of several men, due to the falling of a large portion of the hanging wall.

So long as this good ground lasted the company continued reasonably prosperous, but after 1874 the product declined, and in 1875 was reduced to a few tons; the good ground that had been opened was worked out. In 1876 and 1877 the product continued to be equally light, and the capital stock was so far exhausted that it become necessary to increase it or to surrender the charter; the company accordingly reorganized in 1877; the value of the shares was increased to $50 per share, making the capital stock $1,000,000. In 1878 the stamp mill was totally destroyed by fire, thus cutting off the product entirely. Instead of rebuilding on the old site, it was decided to open the mine on a new

plan. A deep adit that was begun some years ago has been pushed forward. It starts in the vein, at a point about 50 feet above the lake, and has since been driven in to the Spencer shaft—the heretofore main hoisting shaft—a distance of 5,300 feet, and has recently been completed and laid with T rail track. It has a descent to the north of four inches in 100 feet, and intersects the shaft at about 500 feet below the surface. During the present year (1880) the company have built a new stamp mill, rock house, and wash house at the mouth of the tunnel. The loaded cars, after being trammed to the mouth of the tunnel with mules, are drawn up an incline into the rock house, the incline continuing upward after entering the building, so that at the extreme end it has an inclination of about 10° from the vertical; reaching this position the car dumps from the tail end onto a bar screen that inclines about 45°; the smaller portions of rock pass through into the rock bin below, and the larger portions slide down the bars to the floor, whence they are thrown into the breakers and the fragments drop into the bins. From the bins, which have a capacity of about 600 tons, the rock is drawn under the stamps, of which there are two—Ball's latest improved pattern—15 inch cylinders and 7 inch rod, and 450 pounds pressure. There are two tracks entering the building, two separate dumps, and two Blake's crushers. The washers are Collum's, with the latest appliances, and there are two large Evans' slime tables. The capacity of the mill is 300 tons per day—so estimated.

The entire arrangements, from the rock house to the slime tables, are under one roof, practically, and everything is admirably arranged with a view to convenience and efficiency, and is of the most complete and substantial character. The mill is built against the north side of the bluff, which rises from the low land that extends to the south from the lake shore, and a ravine that exists on the east side of the mill affords a very convenient receptacle for the coal, the bottom of the ravine being on a level with the boiler house floor. Three locomotive boilers are in place, and room for the fourth when needed; they are supplied with water by hydrostatic pressure, the water coming from a pond 1,500 feet distant to the southwest, being brought in a pipe laid underground. The water for the stamps and the washing is obtained from two sources—from two ponds, situated at different points on the property. One of them, made by a dam in Owl Creek, up on the bluff above Spencer shaft, catches the drainage from several hundred acres of marshy, meadowy land, forming the plateau of the bluff. The water from this pond will be conducted down the shaft, giving a head of 500 feet, which will be utilized in compressing the air for the power drills, and for such other work as it can be made available to perform; and thence, with the drainage of the mine, it will be conducted under the track, along the bottom of the tunnel to the wash house.

The other source of supply is from a dam across Trap Creek, in the N. W. ¼ of Sec. 7,—a piece of land that was recently purchased by the company for this purpose, and thence the water is brought in a launder 7,500 feet in length to the mill. This launder is an open one, and has a very slight fall; it may be found necessary to make it a closed one to prevent filling with snow, etc. A track runs out from the adit over the edge of the bluff for dumping the waste rock. The blacksmith shop, machine shop, etc., are also connected with the tunnel and with the stamp mill by horizontal tracks, for convenience of running on cars machinery to be repaired, and drills to be sharpened, etc.

The machine shop, standing to the east of the stamp building, is well supplied with lathes, planers, etc., requisite to make all repairs that may be necessary; also a new warehouse has been built near by, and four excellent dwelling

houses are in process of construction. The ground plan of the stamp mill, which includes the rock house and the wash house, is 128x44 feet, and the rock house is 48 feet in height. The washing floor is 84x44 feet, and slopes three-fourths of an inch to one foot.

No copper has been produced since the stamp mill burned in 1878, but considerable mining has been done, in addition to driving the tunnel, and several thousand tons of stamp rock lie in the mine ready to be worked up. The stamps were started the 18th of December last. The tunnel, although driven on a fissure vein, was all dead work, as but very little paying ground was intercepted. The plan of operations is to work the ash bed, as this company was the pioneer in its discovery, and was the first to introduce the Ball stamp on the lake, and has ever continued to work this bed more extensively than any other company; the result of its present enlarged operations are regarded with much interest. The ash bed has, in this mine, an average thickness of about seven feet, and slopes to the north at about 28°, and as it extends east and west indefinitely there is an abundance of ground to work, being 700 feet of track from the level of the tunnel. The same cars will be used in the levels that go to the mill. They will be filled from the stopes and run out to the inclined shaft onto a turn table, and thence up or down to the adit level. The main shaft in the mine will be fitted with a double track, gravity road, so that the down cars will draw up the empty ones. An inspection of the mine reveals some very rich ground, and also broad stretches of ground that is very bare or utterly barren, so that an important fact connected with the profitable working must apparently be to open as little poor ground as possible. It is now definitely known what percentage of copper the rock will yield, and the problem reduces itself to simply bring the cost of production within this limit, and to work up the greatest possible amount of the rock. Mr. B. F. Emmerson, who for eight years has been agent of the mine, has studied the situation thoroughly, and has labored indefatigably to bring matters to the present hopeful condition, and it is safe to conclude that no effort will be spared in the future.

The present force of men employed is 94 surface men and 102 men in the mine. The officers are: President, David Nevins, Jr.; Secretary and Treasurer, John Brooks; office, Boston, Mass; Superintendent at mine, B. F. Emmerson; Mining Captain, Wm. Ludlow.

PETHERICK MINING COMPANY.

As previously stated the Petherick Mining Company was organized in 1861 by the Copper Falls Company. It having become evident to the managers of the Copper Falls that they had more mining territory than was necessary, and more mines opened than one company could properly work, it was first suggested by their agent, Captain Petherick, that a new company be created—organized—to work the Hill mine and the Copper Falls mine, the latter named company confining its operations to the veins further to the east, which had been sufficiently explored to demonstrate their equal value. The ash bed extends northeast and southwest across both properties. Accordingly, the company was organized, and the western part of the Copper Falls location purchased for $30,000, and the mining work continued as it had previously been done, under the direction of Captain Petherick, who acted as agent for both companies. For several years the stamping was done at the Copper Falls mill. Work was continued for a few years in a limited way, and shut down on company account. In 1873 the stamp mill of the Indiana Company was purchased and work was

again resumed, so that in the following year, 1874, the company shipped 167,976 pounds of mineral, which yielded 84 per cent = 141,199 pounds of ingot copper. The expenditures were $49,809.66, and the estimated assets, in excess of liabilities, at the close of the year were $7,324.08. The number of tons of rock stamped was 5,115, which yielded 1.08 per cent mineral; and the yield per fathom was 425 pounds; but it was found that there was insufficient water for stamping purposes; the mill could only run a portion of the year; the expenses greatly exceeded the income; indebtedness accumulated, and in 1877 the property was closed out at a sheriff's sale, and purchased by Mr. Delano, agent of the Phœnix, for Boston parties, who, as the property was not redeemed, have the present year organized a new company called the Ash Bed Mining Company, with a capital stock of $1,000,000 in 40,000 shares. The company have begun to open a mine on the same plan as the Copper Falls. A deep adit has been started on the Hill vein, which will reach 2,700 feet, when it intersects the ash bed, and is 600 feet below the surface, on the lay of the bed. The stamp mill will be built below the mouth of the adit, and the water pumped from the lake. The intention is to open with a capacity of 500 tons of rock per day, expecting to obtain a yield of 10,000 pounds of copper per day therefrom. There are about 25 men employed at work on the adit. The old stamp mill has been repaired, but no product has been shipped. There are about 20 dwelling houses on the location, and some other buildings. The estate comprises 1,100 acres of land in Secs. 2, 10, 11, 14, 15, and 23, T. 58 N., R. 31 W.

Wm. P. Hunt, President; Wm. C. Coffin, Secretary and Treasurer; office, Boston, Mass.; Mr. M. A. Delano, Agent.

THE NORTHWEST COPPER COMPANY.

The Northwest Copper Mining Association was formed in 1847, and held a large body of lands in Keweenaw county, comprising Secs. 13, 14, 15, 24, and half Secs. 10, 11, 12, 23, 25, and ¼ Sec. 26, T. 58 N., R. 30 W.; in all, 4,320 acres, lying south of the greenstone range. Mining work was begun in a limited way on section 15, and so prosecuted for two years, when in 1848 it was deemed best to organize with sufficient capital to enable them to prosecute mining on a scale of increased magnitude. Accordingly a charter, procured from the legislature of Michigan, granted March 9, 1849, under which the Northwest Mining Company was organized on the 15th of May thereafter, and the surrender of the shares of the old company, and the substitution therefor of the shares of the new company duly effected. The president and secretary of the preceding company were William Pettit and James G. Clark, of Philadelphia. Associated with them were a number of well known names of that city and of New York, among whom were Horace Greeley, Oliver Johnson, Geo. H. Thompson, and Charles Schaffer, who were also the corporators of the new company, and James G. Clark became president. The capital stock was placed at $200,000, divided into 1,000 shares, and work was undertaken with a degree of zeal that foreshadowed a better result than was eventually realized.

There were three mines opened on fissure transverse veins south of the greenstone, called respectively the Stoughtenburgh, Hogan, and Kelley. The former bears N. 16½° W., and the two others bear N. 19° W. The Stoughtenburgh vein—the one shown in the longitudinal section given in this report—was opened with four shafts and an adit. The total length of the shaft had reached, in five years, 1,130 feet, and the levels an aggregate length of 5,450

feet. The deepest—next to the greenstone—being down 500 feet, and the longest level being 1,000 feet in length, and these levels had stoped about 3,000 fathoms. The vein did not produce a large amount of stamp rock, but masses weighing from a few hundred pounds up to several tons—the largest 11 tons—were frequently met with. They were generally found outside of the lode, but adjacent to it and isolated, with no other copper in the immediately surrounding rock. The lode has a variable width averaging about 12 inches, and as at the Cliff, crosses a series of amygdaloid floors, which had a marked influence on the vein, and from them was afterwards obtained the greater portion of the stamp rock.

The Hogan vein was also opened, but less extensively worked than the former, and some work was done in what was called the Clark vein, and a cross-cut from the Stoughtenburgh to it was nearly completed.

The first stamp mill was put up in 1849–50 and run by water, but proving entirely inadequate, from want of power, a new stamp mill was erected with 24 heads—operated by steam power—in 1852. Soon after this stamp mill was started the agent, Mr. Wm. Petherick, kept an account of the result of the work—the first of the kind on the lake: Total number of tons stamped in three months, 1,451; yield of copper, 39,693 pounds; per cent of copper, 1.34; pounds of copper in ton of rock, 27.4. The total cost per ton of rock, including all incidentals of every description, from its place in the mine to the finishing up in the work house was $4.42. The market value of the copper was $6.97, leaving a net profit of $2.55 per ton of rock. The average yield of mineral per fathom up to this time was estimated to have been 225 pounds; at the same time in 1852 a heavy engine with pumping and winding machinery were put in to operate the Stoughtenburgh mine. It illustrates the vexation and cost of mining on the lake at that early day, in the fact that four months' time was consumed in transporting this machinery from Pittsburg to its destination at the mine. In three years' time there was produced as follows:

	Pounds Mineral.	Pounds Fine Copper.	Per Cent.	Sold For.
1849	44,196	34,322	77¾	$ 5,672 71
1850	270,873	195,020	72	35,786 66
1851	434,993	393,199	67½	53,360 46
Total	750,062	522,541	69¾	$94,819 83

But the expenditures for the same period were $172,183.96. An agent was sent to England to negotiate the sale of the property, but the London parties were unwilling to purchase unless the company retained a part interest, which they declined to do, and the negotiations fell through. The product of the mines, notwithstanding all the effort that was made, could scarcely be brought above 100 tons per annum; but the agent, Mr. H. H. Beecher, being strongly impressed with the richness of an amygdaloid belt cut by the veins, urged upon the directors the importance of increasing the stamping facilities, which in reality were very meager, owing to a want of water during a great portion of the year. It was decided in 1859 to build a new stamp mill, and the site chosen was on the bank of the Montreal river, where it was thought there would be no lack of water. Forty-eight heads of Wayne stamps were purchased; the

engine was esteemed of sufficient power for a greater number when required, and it was also intended that water should be pumped from the new mill to the old one to eke out its supply. A railroad—double track, 1,200 feet long—was laid, connecting the mill with the mine, having a grade of 94 feet, so that the descending cars draw up the empty ones.

It was found to be extremely difficult to adjust the finances of the company to provide for the expenditures; advances had to be obtained from the consignees of the copper, and not unfrequently the directors were obliged to give their individual guarantee; but, notwithstanding, it was announced that the company had arrived at a position where the stockholders would be soon amply compensated for their previous patience and expenditure. The agent reported the property to be worth millions.

The company had laid out the village of Wyoming (now locally called Hell Town), and sold the lots, and up to this time 77 houses had been built there.

But with the two stamp mills, by the aid of which so much was anticipated, the condition of matters did not seem to improve; they could not, and never did in any year produce copper enough to meet the cost of obtaining it.

The amygdaloid bed was said to be 10 to 15 feet thick, and was opened with an inclined shaft, and believed to extend indefinitely east and west, and probably hold equally rich. The rock was found to work up easily, and it seemed that all that was required was sufficient facilities to get out and to stamp 100 tons per day to make it the richest mine on the lake.

At the close of 1859 over $611,000 had been expended, and the receipts from the sale of copper had amounted in all to $328,000. The indebtedness continued to increase until the company was finally threatened with overwhelming financial disaster. The excess of the company's liabilities amounted to $130,000, and there was no longer any means of meeting them; the capital stock was exhausted and even the interest on their bonds was unpaid.

PENNSYLVANIA MINING COMPANY.

In this emergency a meeting of the stockholders was called, who resolved to reorganize under the general mining laws of the State of Michigan, with a capital stock of $500,000 in 20,000 shares, to which organization, when perfected, the Northwest should sell all its estate, real and personal, in consideration of the new company assuming its liabilities. This plan was carried into effect, and in November, 1861, the Northwest Mining Company ceased to exist, and in its stead there was created a new organization to be known as the Pennsylvania Mining Company of Michigan, with the office, as had been that of the previous company, in Philadelphia.

Joseph G. Henszey became president, and S. M. Day, the former secretary and treasurer, continued in that office.

The lands comprised 2,880 acres of mineral land in Keweenaw county, and 6,000 acres of timber land in the same county were soon after purchased. The actual results of the experience of the Northwest, notwithstanding the numerous statements which had been made, based upon limited tests to the contrary, showed that the old mine had not been worked with profit. Only 260 pounds of copper could be obtained per fathom from the average ground in the vein, while the cost had been more than $100 per fathom for working it. It seemed that a sufficiently thorough trial had been made, and in view of the unfortunate results, it was thought advisable to seek a new location. Mines were opened on what were called the Eagle vein, Branch vein, and the Trotter

vein, and the underground workings were made to conform to those of the Cliff and the Central. Mr. S. W. Hill was engaged as agent, and his sanguine reports regarding the mineral value of the property served to imbue the members with much confidence, and a successful future seemed to be certainly assured.

A new stamp mill was built—the largest on the lake—and provided with the most approved appliances; a large amount of surface improvements were made, consisting of buildings, saw-mill, road to Lac La Belle, the stamp mill, railroad from the mine—gravity incline—1,300 feet in length, new engine for hoisting and winding apparatus, etc. In these improvements there was expended over $126,000, and no copper had been produced.

THE DELAWARE MINING COMPANY.

In 1863 the Delaware Mining Company was organized and 720 acres from the west side of the estate were set off to it, for which the Delaware paid the sum of $100,000 in stock. In other words there was divided among the stockholders of the Pennsylvania Company 4,000 shares of the new company's stock.

These two companies worked largely and expended in mining and improvements nearly $2,000,000. Two large stamp mills were built costing $200,000. Among the projects inaugurated—and although never accomplished, is still a favorite one with the successors of these companies—was the construction of a railroad to Lac La Belle. The latter had been made so that vessels could enter, and it could easily be made one of the best harbors on the lake. The Pennsylvania and Delaware were strenuous in their efforts to secure the construction of this road.

But there was, comparatively to the surface outlay, but little mining done, and the companies failing to meet their pecuniary obligations, the properties were taken possession of by the bondholders in 1866, and in the following year work was begun by the bondholders and the mines put under the charge of Mr. W. H. Spaulding as agent. This was continued for two years, when the bonds were purchased by Ed. M. Davis, of Philadelphia, who took possession of the property and assumed the direction of affairs in person. A new organization was made including both properties in one company, called the Delaware Copper Mining Company, which arrangement was consummated in 1876. Under this organization work has continued up to the present time.

Work was begun under the charge of Capt. A. P. Thomas, formerly of the Copper Falls mine, on the Delaware vein. The shafts were refitted with new skip and tracks and sunk to several additional levels, but the result was not any more encouraging than it had been in former years, so that it was concluded to reopen the old Stoughtenburgh mine. A new shaft house was built over the north shaft (No. 1), a substantial building for the hoisting engine and winding machinery built, a good steam boiler house built, etc. During the past season a fine rock house was built, 63x40 feet, and 53 feet in height. An elevated trestle work carries the railroad track from the shaft house to the rock house, and a second horizontal track connects with the stamp mill. The rock, after being manipulated at the rock house, passes through shutes into the cars which convey it to the stamps. The depth of the main shaft is 550 feet from the surface, and the levels are opened in length in the vein from 500 feet to 1,200 feet, and east and west drifts in the amygdaloid beds extend from 200 to 400 feet.

Some explorations and discoveries which were made a year or two ago in the

conglomerate belt, which underlies the greenstone, are deemed by Agent Thomas, who is a mining man of much intelligence and of long experience in the copper region, as of great importance. He has recently begun the sinking of four shafts in this bed, east from the mine and distant apart about 400 feet, and thus far the indications are favorable; the bed shows a good width, the vein matter appearing well charged with copper. Captain Thomas feels confident that this belt will afford a return that will redeem the unfortunate financial past of this old mining location. Under this promising outlook a new change of base has been determined on, and a new company organized,

THE CONGLOMERATE MINING COMPANY,

to which the Delaware has sold its entire property, real and personal, for 50,000 shares of the new organization, the company being organized with 100,000 shares of $25 each. The remaining 50,000 shares have all been subscribed for, and an installment of $2.50 per share has been paid in. The officers of the new company are Henry C. Davis, President; Chas. M. Foulke, Secretary and Treasurer, Philadelphia; A. P. Thomas, Superintendent at the mine. This organization was consummated in October last, and goes into effect in January, 1881.

The entire estate comprises 20,000 acres of land, in which is included the lands surrounding Lac La Belle formerly owned by the Mendota Company. The estate is the largest held by any company in the copper region.

In opening the new mine on the Conglomerate, the shafts will be worked by the present engine and machinery as now placed at No. 1 shaft. Work on the Conglomerate is now going forward and the deepest is down 40 feet (December, 1880), but no product has yet been taken out.

The number of men employed by the company is 250, of whom 100 are miners. Rand's compressed air drills are used. The product for the present year is less than it would have been, owing to the fact that the rock house was not completed until October. They are now stamping 160 tons per day, yielding 1 per cent, or about 40 tons per month. The stamps are Gates' pattern, 48 heads, each 1,200 pounds weight, and with 36 inches fall. The washers are old style, and the water is pumped from a pond made by a dam across the Little Montreal river. The size of the stamp building is 100x120 feet. The boiler house is of stone, 30x100 feet, with four cylinder boilers.

The amygdaloid bed extends east and west across the property, and dips with the formation, and has a thickness of from 20 to 30 feet. The location is certainly favorable for working to advantage, and if the Conglomerate mine proves successful it is intended to build the long-talked-of railroad to Lac La Belle, where the stamp mill will be placed.

The accompanying section shows the Stoughtenburgh mine, which was opened in 1846, and worked, as has been previously related, until 1861, when it was abandoned and the machinery removed. Work was resumed again in 1878, and if it is continued in the future it is intended to sink an inclined working shaft in the amygdaloid level.

Some explorations were made at the Delaware with the diamond drill in 1877 with the following result: The aggregate depth of ten holes was 1,612 feet, with an average cost per foot of $1.35½, itemized as follows, to wit:

Labor	$1,125 28
Supplies	44 36

Diamonds	$827 20
Freight, etc	67 06
Fuel	123 20
Total	$2,187 20

An effort was made in 1863 to establish an independent company—the New Jersey—to work the land adjacent on the east. Six hundred and forty acres of land were here set off, and some outlying lands also included, but the project never came to anything and the lands fell back to the original owners.

Another company, the Maryland, was started by three gentlemen, but had only a name. The location was section 24.

The owners of the Pennsylvania and Delaware in 1865 organized the Wyoming Mining Company, location sections ten and fifteen, bordering on the south side of Musquito lake. Several transverse veins bearing northwesterly are here exposed, lying south and north of the greenstone, and it was proposed to open with a deep adit starting from Musquito river to secure drainage. The prospectus announced most extraordinary prospects and inducements, but the anticipated finds were not realized.

MINES ON THE POINT—CLARK MINE.

East of the Delaware there are a great number of locations on which, in the early period of mining on Lake Superior, more or less labor and money was expended, but none of them prospered or made any money and all have for many years been practically idle. The elevated and exposed position of the rocks rendered this portion of the range easy to explore, and the frequent occurrence of copper bearing veins afforded irresistible opportunities for mining venture.

Among these enterprises are the mines of the French Copper Mining Company of Lake Superior, comprising the Agate Harbor, the Clark, Montreal and Bell. The former location comprised 2,500 acres, being parts of Secs. 5, 6, 7, 8, T. 58, R. 29, and parts of Secs. 1 and 12, T. 58, R. 30, lying north of the greenstone. There are a number of veins crossing the tract, but are not believed to possess particular value, and but a small amount of mining was done. The ash bed here may be ultimately shown to have value. The location of the latter three mines consists in all of 2,500 acres bordering on the south of Lake Fanny Hooe, and only one-fourth of a mile from Copper Harbor, one of the best ports on the lake. The location extends both north and south of the greenstone and is thus crossed by the ash bed and the amygdaloid formations. The Clark mine, so called, has been worked on two different veins, and work has been more continuously prosecuted here than anywhere else in this portion of the copper district, and much money sunk in a determined effort to achieve the success that has been unfortunately wanting. The mine is on the N. E. $\frac{1}{4}$ of Sec. 9, T. 58, R. 28, and the veins bear N. 10° W. and have been mined on both sides of the greenstone.

The Montreal mining property originally comprised portions of Secs. 8, 9, 17, T. 58, R. 28, and the principal vein is the continuation of the black oxide first opened at Copper Harbor, and subsequently at Lac La Belle.

In the two veins at the Clark mine were opened each with an adit and three shafts, provided with engines for hoisting and pumping, and the mine supplied with a stamp mill. Small masses have been frequently found; enough to give

encouragement, but not enough in the aggregate to pay the cost and make the mine self-supporting.

The Original Company was organized in Paris, France, May 14, 1858, and dissolved June 15, 1860, the property advertised to be sold, and the proceeds applied to liquidate the debts. The mine was purchased by Edward Estivant, of Paris, and is now in charge of Leon Lauraux, resident agent. The present estate comprises the original Clark, Montreal, and Bell locations.

The stamp mill was built in 1872 at Lake Manganese, and was run by water power with 16 head of stamps. The water is conducted through 15-inch pipe a distance of 1,800 feet. The rock-house is provided with Blake's crushers, and a railroad connects the stamps with the mine. The mine is closer to the greenstone than any other in the district. Since 1878 but little or no work has been done at the mine. The organization is known as the Copper Harbor Mining Company.

EAGLE HARBOR MINING COMPANY.

Eagle Harbor and Waterbury Mining Companies originally held a large body of lands, comprising 7,000 acres, out of which territory, from time to time, several mining locations have been made. These, early worked to a limited extent, were the Waterbury mine, comprising the E. $\frac{2}{3}$ of Sec. 17, T. 58, R. 30, and the Eagle Harbor property was comprised in Secs. 4, 5, 6, 7, 8, 9, 18, and W. $\frac{1}{3}$ of Sec. 17; the Connecticut the W. $\frac{2}{3}$ of Sec. 16.

All the above, together with an additional stretch of ground extending two miles to the south, and of one and one-half miles width, now belongs to the Eagle Harbor Company.

Mining was prosecuted on the Waterbury location to a limited extent from 1850 to 1854, but without any favorable result.

The Connecticut opened on a fissure vein south of the greenstone in the W. $\frac{1}{2}$, S. E. $\frac{1}{4}$, Sec. 16, and continued work for several years, getting out a moderate product, but not enough for profit; in 1857 work stopped on company account, and was continued for a time on tribute.

The old Eagle Harbor mine works were on section 9, north of the greenstone, on the same vein afterwards worked by the Connecticut.

In 1864 an effort was made to organize three mining companies to work the lands south of the greenstone; this territory was divided into three strips, each one-half mile east and west, and two and one-half miles north and south, situated between the Amygdaloid Company on the east, and the Madison on the west. These divisions were called, respectively, the Sussex, Middlesex, and Essex, the latter the east division. The company was the original proprietor of the village of Eagle Harbor. Office of the company, No. 4 Exchange Court, N. Y. W. Hart Smith, Secretary and Treasurer.

STAR MINING COMPANY.

The Star is one of the old companies located on the point that preserves its organization. The mine is situated on the E. $\frac{1}{2}$ of Sec. 9, T. 58, R. 28, and was opened on a fissure vein south of the greenstone. Mining work was begun in 1851, and continued until 1857; two shafts were sunk—No. 1 to the depth of 300 feet, and $70,000 expended. Work was resumed in 1864, and a small amount of copper was taken out. Recently some interest has been awakened in regard to the discovery on the property of a deposit of black oxide of

copper, but probably it is the continuation of the same vein originally opened at Copper Harbor, where it was soon worked out.

EAGLE RIVER MINING COMPANY.

The Eagle River Mining Company was organized under the general mining laws of the State, February 5, 1853.

The company held 680 acres of land in sections 28 and 29, T. 58, R. 31, in Keweenaw county, being two and a half miles south from Eagle river and adjoining the Phœnix. The owners were Cleveland parties. A. H. Barney, President; Clinton French, Secretary and Treasurer; Col. Chas. Whittlesey, Superintendent.

Mining was begun in what was called the Babbitt vein, crossing the W. ½ of Sec. 29 and bearing N. 25° W. The vein extends about three-quarters of a mile on this property, and was opened by two shafts 275 feet apart, No. 1 close to the outcrop of the greenstone, and by an adit started from high water mark of the Eagle river, giving drainage for 300 feet elevation. The vein was a good deal split up, and it seemed doubtful if the mining was being done in the main vein. In 1855 a small stamp-mill was put up, run by water, with eight heads of stamps. A small amount of copper was shipped for several years—about 25 tons in all.

DANA MINING COMPANY.

The Dana Mining Company's location was bounded on the west by the Northwestern, and on the east by the Summit, and on the north by the Copper Falls, extending from the top of the greenstone ridge, one and a quarter miles to the south, being the E ½ of Sec. 24 and the N. ½ N. E. ¼ Sec. 25, T. 58 R. 31.

An examination of the location was begun in 1851. Several transverse fissure veins were discovered and mining was begun in the most northwesterly one by an adit and three shafts being driven and sunk, No. 3 shaft being started near the greenstone and No. 2, 371 feet south, No. 1, 282 feet south; the adit was 780 feet. This vein proving poor, as depth was attained, was abandoned in 1853 and work begun on another vein, which proved somewhat better. Work was continued until 1857, and then abandoned.

SUMMIT-MADISON MINING COMPANY.

The Summit Mining Company was organized in 1852–53, owning Secs. 19–30, T. 58, R. 30, and began mining work by opening two veins south of the greenstone, on the W. ½ Sec. 19. The veins are about 200 feet apart. In the prospectus the directors announce that the true plan in opening a mine is to start with sufficient capital in the treasury to fully equip and prove the mine; and thus, having provided the funds in advance, they proposed to bring the Summit to a paying point sooner than had ever been done with any mine in the copper district.

Starting with a working capital of $100,000 in cash they deemed themselves well provided to develop the mine and make it productive in a very brief period, and expressed the confident belief that the Summit would soon rank with the best mines in the country.

The location, as are nearly all those along the south side of the greenstone, is a favorable one for opening with an adit for drainage, and the Little Montreal river, which flows east along the base of the bluff, supplies a moderate amount of water. There were subsequent additions to the property so that

the estate extended upwards of three miles north and south, and one mile east and west. The amygdaloid beds, apparent in other mines opened south of the greenstone, also occur here.

Mining work was continued until 1856, but contrary to confident predictions of the officers at the outset, the mine did not pay, and work was suspended and not again resumed until 1863. In the meantime, in 1859, the concern had been reorganized as the Madison Mining Company. Eight years had elapsed since the location had been abandoned, and no attention had been given to it.

The houses were renovated, the stamp mill repaired, a saw-mill erected, an engine house was built, a shaft house at No. 2; hoisting and pumping engines were procured, and the necessary winding and pumping machinery added and the mine relieved of water. No. 2 shaft was furnished with a skip, and a launder, 1,500 feet in length, built from a dam in the Little Montreal river to the stamp mill. The first assessment, $1.00 per share, was made in 1863, in March, but in the following months of May, September and October three additional assessments of $1.00 each were made, and in July and in August, 1865, two more assessments, $1.00, were called in, making $140,000 expended and only five tons of copper got out which yielded 68 per cent. A change in the local administration was made and Capt. John Uren was engaged as agent. He reported that he found very little productive ground, not enough to keep the 16 stamps at work, but as so much money had been expended, he thought it unwise to suspend until the mine had been proved at greater depth, especially as by stopping and allowing the mine to fill with water much of what had been done would be lost.

The most judicious plan, in his opinion, would be to open the mine on the east vein below the 20 fathoms level. About $8,000 remained in the treasury, and it was hoped ere that sum was exhausted something would turn up to advantage. But not much more was done by the company. The mine was leased to Capt. Uren on tribute, and he took out 40 tons of mass copper in 1866. Capt. Uren wanted to lease it for three years, but the company would only lease for one year, which would not give sufficient time to warrant extending the necessary openings for profitable work. The mine thus lay idle until 1876, when the company again began work and expended $15,000, and called upon the stockholders for an assessment which they refused to pay. An indebtedness had been incurred, and the property in 1878 was sold at sheriff's sale, but the company redeemed it, and in September, 1879, the concern was again reorganized with a capital of $1,000,000 in 40,000 shares, 10,000 of which were held to be sold to raise a working capital. In September last (1880) work was again resumed under the charge of Capt. Joseph Snell, agent. Only a small force is at work, working in the east vein in the north end of the mine. The conglomerate belt which underlies the greenstone is here only about six inches wide, while at the Delaware, three miles to the east, it becomes of sufficient width to encourage the hope that the working of it will give a great profit.

The company now owns three sections of land. Work has been done on three veins, but the west vein dips to the east at an angle of about 75° and the east vein dips to the east, so that they will intersect at about the 150 fathom level. They are now sinking from the second level, below the adit, which is 80 feet below the surface. The formation is similar to the central, but does not carry mass copper like the central vein. It is probable that the mine will be worked more cautiously than it has been in its previous history. In the first prospectus of the original company, issued a quarter of a century ago, it

is announced that they were in possession of the experience of other companies and could profit by their mistakes. In making this new start the new Madison needs, perhaps, no better warning than the experience which is afforded by the old Madison.

The office of the company is in Boston, Chas. H. Ward Secretary and Treasurer.

BLUFF MINING COMPANY.

The Bluff Mining Company, location N. W. ¼ Sec. 15, T. 58, R. 29, opened a mine on a fissure vein of about 12 inches in average width, with two shafts, and sunk to the third level and drifted 600 feet. This work was begun in 1852 and continued for two or three years thereafter, and finally abandoned.

THE IRON CITY MINING COMPANY,

worked during the same period on the adjoining section to the east—14—T. 58, R. 29. Two shafts were sunk 300 feet apart, No. 1 to a depth of 300 feet and connected by levels. The vein proved to be wide but failed to yield copper in any amount. The company also held the section to the north—11—and sunk several shafts and did some drifting in a narrow vein that proved unproductive.

ALBION-MANHATTAN MINING COMPANY.

This company worked during the period of its existence two locations. The first, on which work was begun in about 1848, was on Sec. 11, T. 58, R. 32, west of the cliff, adjoining the old North American. Here a shaft was sunk 115 feet, through the greenstone; an adit was driven in from the south to intersect the shaft, which was carried down 200 feet below the adit level. The vein is said to have been 2½ feet in width, but proved barren in copper. The location was abandoned in 1852 and subsequently came into the possession of the Manhattan Mining Company in 1856, who sunk a shaft 70 feet, near the greenstone and obtained about five tons of copper. In 1857 the work came to a stand-still and was not again resumed until 1862 when an effort was made to build up the enterprise. A little work was done for a few years and then the location was again abandoned and no work has since been done. Some ruins now mark the location.

GARDEN CITY MINING COMPANY.

This company was organized in 1855 with a capital stock of $500,000 in 20,000 shares, holding 720 acres of land in two tracts, distant apart about 12 miles, but the mining location was in the N. W. corner of the S. W. ¼ Sec. 11, T. 58, R. 31.

Two shafts were sunk in the ash bed in 1856. A large stamp mill was built, 60-horse power engine and 32 stamps, furnished with water by the Eagle river. The washing was at first done in hand buddles, but the process proved too primitive and slow, but want of funds prevented the purchase of more improved apparatus, and work ceased in 1858, but was resumed again in 1859. In 1860 the two shafts were to the depths of 148 and 60 feet, and each was intersected with an adit, of lengths 115 feet and 92 feet respectively. An incline had also been driven down in the vein 75 feet to intersect the No. 1 shaft, and from the bottom of this shaft a level had been driven west 115 feet. The inclined shaft

was provided with a skip road and shaft house. A rock house had been built furnished with Blake's washers, and a gravity road connected it with the stamp mill. A sufficient number of dwelling houses, shops, offices, etc., had been erected, forty acres of land got under cultivation, 2,500 pounds ingot copper obtained, and a total expenditure of $66,500 incurred. The proprietors were Chicago parties and the office was in that city. The total product has been about forty tons of refined copper. No work has been done since 1866.

In 1879 the company was re-organized as the Caton Mining Company, but no work has been done on the property.

FULTON MINING COMPANY.

The Fulton Mining Company began work in 1853 on the S. E. ¼ Sec. 33, T 57, R. 32, a location that had been worked six years previously and then known as the Forsyth mine. The company held in all 3,000 acres of so-called mineral lands.

The mine was opened on a fissure vein with four shafts and an adit level. Near the surface the vein, which has a width of eighteen inches, yielded considerable silver, and between shafts three and four several tons of copper in small masses were found. The company hold sections 26, 27, 33, 34, 35 and parts of sections 22 and 23, T. 57, R. 32. The Kearsarge conglomerate and the Kearsarge amygdaloid cross the northwestern portion of the property.

Shipped in 1853 1,255 pounds refined copper.

SENECA MINING COMPANY.

This company own Secs. 20, 21, half of 22, and 23, Secs. 28, 29, 32, in all 3,240 acres near the south line of Keweenaw county and at the southern extremity of the greenstone ridge.

Some work was done 15 years ago on the N. E. ¼ Sec. 32, on what is called the Kearsarge conglomerate, lying south of the Calumet conglomerate and between it and the Kearsarge amygdaloid. The ground here is low and somewhat wet, being at the head waters of the Trap Rock river. Work at this point was renewed early in 1880 under the direction of Capt. Daniels, agent of the Osceola Mining Company, with a view to thoroughly prove the value of the lode. The work to the present time comprises the sinking of two shafts in the conglomerate belt to a depth of about 200 feet each; hoisting and pumping engines have been erected, suitable shaft houses and about a dozen good dwellings have been built. The property is controlled by the president of the Osceola, Joseph W. Clark, who owns the majority of the stock.

The organization of a new company to work this mine was decided upon in March last, and it is proposed to set off to it about 800 acres of the Seneca estate. The matter has not yet been fully consummated. If the mine proves sufficiently favorable a railroad will be built to Torch Lake, seven miles to the south. where the stamp mill be put up. The company are now employing 30 men. President, Joseph W. Clark; A. S. Bigelow, Secretary and Treasurer. Office 198 Devonshire street, Boston. The new mine is called the Ahmuk.

THE ARNOLD ET AL.

During the winter of 1879–80 a large number of defunct mining companies were resuscitated, some of them under the old name and some were re-organized and assumed new names. Among them, all owned in Boston, are the

Arnold, comprising 1,200 acres, adjoining the Petherick on the west, and having the ash bed formation across it; the Atlas—west of the Phœnix—between the Phœnix and the Cliff, and south along the greenstone. A fissure vein was formerly worked on this property, and some of the houses and mining plant still remain.

THE CALUMET BELT MINING COMPANY.

Organized in Boston, with a capital stock of $250,000. The property is situated between the Cliff and the Central mines, and comprises 1,800 acres of contiguous mineral lands. The amygdaloid and conglomerate belts extend two and a half miles on the property. This company has yet done no mining work.

MEADOW MINING COMPANY.

The Meadow mining location is the N. E. ¼ of Sec. 20, T. 58, R. 31, adjoining the Phœnix on the east. This quarter section is crossed by the ash bed, and was first explored in 1851 and a few years after some mining done. The property is also crossed by transverse fissure veins which when first discovered were lined with ancient pits, in some of which considerable copper was obtained. The company was organized under a special charter in 1853.

AMYGDALOID MINING COMPANY.

This company was organized in July, 1860, with a capital stock of $500,000 in 20,000 shares. The owners were mostly Philadelphia men. Mining work was begun on the S. E. ¼ of Sec. 16, T. 58, R. 30, and prosecuted on an extensive scale. A large number of houses for miners, etc., were built, and expensive mining plant procured, which latter included the erection of a stamp mill furnished with 32 heads of stamps of Gates' pattern. Three fissure veins were worked, but the main mine is in what was called the Drexel, south of the greenstone. Up to the close of 1862 the company had received from the sales of copper the sum of $44,458.88, and from sales of silver, $558.50. During that year an inclined railroad was built from the mine to the stamps, a distance of 1,600 feet. Winding and pumping machines were put in also in that year, together with engine of ample power; seventeen log tenements, each 18x22 feet, and costing each $155; also office, rock house, furnished with six rock breakers, drum house for the gravity incline, were built the same year. The shipment for 1862 was 190,514 pounds mineral, yielding 72½ per cent ingot= 138,124 pounds ingot, which sold for 32.82 cents per pound.

In the following June, during a period of dry weather, the company's surface improvements were nearly all destroyed by fire. The stamp mill, saw-mill, tenements, change house, etc., were burned. The fire originated in the woods, where it had been running for several days, and a gale of wind arising and blowing in the direction of the settlement soon obliterated it. This unfortunate mishap was a serious set-back, but the energetic agent, A. C. Davis, went to work with so much vigor that by November of the same year he had constructed 41 tenement houses. The saw-mill had been rebuilt and furnished the lumber, shingle, etc. In addition were built an agent's house, smith's shop, change house, barn, office, etc. A stamp mill building and boiler house, both of stone, were built and the stamps got in June, 1863. The destruction by the fire, especially of the stamp mill, and the necessity of devoting a large proportion of the force to repairing the loss, necessarily crippled the mining

work. The shipment for 1863 was 109,590 pounds, yielding 70.63 per cent== 77,406 pounds ingot, which sold for $24,499.46. The cost of smelting at Philadelphia, including freight, insurance, barrels, commission, etc., was 2.89 cents per pound. Some additional lands were bought, making the estate 1,760 acres.

In 1864 another great misfortune was met with. The new stamp mill, which had been but recently completed, and which was deemed to be substantial enough to bid defiance to all elements of danger, was, after two months' run, again brought to a stand-still by the bursting of both boilers—happening when copper was at its maximum price. An opportunity was thus afforded for the expectant stockholder to reflect upon the vicissitudes of human hopes and to moralize upon the evil results of a too free indulgence in the use of intoxicating liquors, and the advantage of having in future a sober engineer. The mine was reported as presenting the most excellent prospects for a future yield.

The improvements made in 1864 comprised the completion of the stamp mill, the construction of 3,000 feet of railway, laid on trestle work, a portion of which was covered, rock crushers; some dwellings, shops, barns, roads, etc., were built.

From the greenstone slide at the amygdaloid, south, the ground has very little descent compared to the Cliff and some other locations, so that strong, high foundations had to be built to the engine-house that worked the shafts, and the shafts were run up to an increased height to give space below for the waste rock. The great scarcity of men in 1864 on the lake led the agent to try the experiment of importing from Canada, but the men ran away as soon as they arrived in order to avoid paying their fares and their board; so that instead of deriving advantage the company was out a few hundred dollars. The shipment for 1864 was 195,664 pounds, yielding 69 per cent,==135,795 pounds. The total cost of packing, shipping, freight, insurance and commission was 4 35-100 cents per pound of ingot, and the product sold at an average price of 48¾ cents per pound.

The copper that was produced in the winter of 1864–5—when labor was excessively high—could not, of course, be sent to market until navigation opened in the spring, at which time the price had declined from upward of 50 cents per pound to 28 cents per pound. The price, however, advanced later in the season, but did not reach a market value at all commensurate with the continued high price of labor, cost of transportation and of materials. The product for 1865 was 584,092 pounds, yielding 418,964 pounds ingot.

The Amygdaloid based its hopes of success chiefly on working the amygdaloid belt which had appeared so favorable in the adjoining Delaware mine and in the Pennsylvania and even at the Cliff, etc. It was claimed that the amygdaloid belt would prove an enduring source of profit; masses, as at the Cliff, Minesota and National, would play out, but this amygdaloid on the south slope and the ash bed on the north slope could be depended on for a permanent yield.

A cubic fathom containing 216 cubic feet, and estimating the weight at 175 pounds per cubic foot, the weight of a cubic fathom would be 37,800 pounds, which in an average vein 18 inches wide would be 113,400 pounds for each six feet of vein in depth and in length, and estimating the percentage of copper to be 1¾ per cent, there would result 1,984 pounds pure metal, which at 21 cents per pound would give $416.64. The items of cost for mining, stamping, smelting, etc., were estimated at about $200 for each fathom, as above; thus leaving a clear profit of $216.64 for each fathom of vein rock. Such reasoning sold stock and kept up the flagging hopes of reluctant stockholders and induced the

payment of assessments, but down to the present time the results have been the reverse of all this.

The mines yielded their maximum product in 1865. The following year the product diminished to 170¼ tons of ingot, and the company shut down. From this time, for the next four years, the mine was worked on tribute, producing in 1867, 80 1375-2000 tons; in 1868, 61 644-2000 tons; in 1869, 16½ tons; in 1870, 23 1610-2000 tons. In 1872 the company raised a final assessment of $10,000, which exhausted its capital stock, and expended it in an effort to again resume operations, and in the two following years a small product was obtained,—in 1873 14 250-2000 tons, and in 1874 7 1840-2000 tons. In 1878 1,259 pounds were taken out on tribute, since which time no copper has been taken from the mine. The tribute work has consisted in hunting for barrel-work, and has resulted in leaving the underground workings in bad shape. The total product of the mine is 770 1180-2000 tons ingot copper, and the assessments have been in amount $500,000, the full sum of its capital stock.

The location now presents a melancholy aspect, with the large number of buildings, long railroad trestle, great shaft houses, engine house, stamp mill, and other extensive mining plant, and surface improvements, neglected and going to ruin. The office is No. 324 Walnut street, Philadelphia. Geo. L. Oliver, President; F. K. Womrath, Secretary and Treasurer.

NATIVE COPPER COMPANY.

Adjoining the Delaware on the north, Sec. 10, T. 58, R. 30, is the location of the Native Copper Company, which worked in a vein crossing the ash bed in 1852 and for a few years thereafter, in a limited way, with the same results as other companies similarly situated.

And the Winthrop—S. W. ¼ Sec. 23 and W. ½ Sec. 26, T. 58, R. 30—adjoining the Central on the west,—began work on a fissure vein in 1852, and expended in assessments $90,000 without any very encouraging result.

On the S. W. ¼ Sec. 12, T. 58, R. 28, a mine was opened in 1846, and worked again in 1852 and 1853 by the New York and Michigan Mining Company. The mine was opened to a depth of 150 feet on a vein 20 inches wide. 1,800 pounds of copper were shipped in 1852.

The Humbolt, also located on the ash bed, Sec. 21, T. 58, R. 31, worked on several veins, commencing in 1853, and made assessments to the amount of $100,000.

Several companies holding contiguous locations of 240 acres each, in T. 57, R. 32, were organized in 1863–64, but did very little mining work. Of these are the Providence, Home, Hope.

THE HANOVER

was formed in 1860 to work an old location, the W ½ Sec. 8, T. 58, R. 28. Two fissure veins were opened here and $20,000 expended and the location abandoned.

MENDOTA MINING COMPANY.

Mining in the vicinity of Lac La Belle was inaugurated at a very early day. The situation affords every opportunity for economical working. Here are found veins of sulphurets of copper, gray and black and copper pyrites. Previous to 1850 the Lac La Belle Company had driven a tunnel into the hill in the vein 400 feet, and found the vein 18 inches wide, bearing sulphurets of cop-

per. A deep adit was also driven in the same vein a distance of upwards of 1,000 feet. This work was done in the base of the Bohemian mountain, which rises above the beautiful little lake at its foot, a distance of 864 feet. No further work was done on the location until 1866, when the Mendota Mining Company, owning 4,320 acres of land surrounding Lac La Belle, did some additional work to the amount of 308 feet of sinking and 740 feet of drifting. The location of the veins on which this work was done is Sec. 29, T. 58, R. 32, and Sec. 29, R. 29.

This company undertook the construction of a ship canal connecting Lac La Belle with Bete Grise bay, which it completed in the fall of 1866 so that vessels entered. This work cost about $100,000. The company received from the United States government a grant of lands—100,000 acres—which were located in Schoolcraft county.

Lac La Belle is about two and a half miles long east and west, by one mile to a half-mile wide north and south. The lake lies on the line between townships 57 and 58 N., R. 29 W., and the east end is about three quarters of a mile from the shore of Lake Superior, with which it is connected by a tortuous channel. The waters of the lake are deep and pure, and when once entered becomes a safe and commodious harbor for the largest vessels. The canal is simply a channel cut due east and west between the lakes, and was so far completed as to allow vessels drawing 11¼ feet of water to enter in the fall of 1866. The company was authorized to collect tolls at a rate fixed by the county board of supervisors.

In anticipation of future growth and importance a village—Mendota—was surveyed out and lots to the value of $13,600 were sold and some buildings erected. The Pennsylvania and Delaware companies built a road to the lake costing $12,000, and constructed there a dock and warehouse, expending $10,000. The Lac La Belle smelting works expended, it is said, in construction here $43,000.

A railroad company was organized to build a line from the Cliff mine along the range to Lac La Belle, but the failure of the mining companies to furnish a sufficient product to make business for such a road, prevented the construction of it being undertaken. The work on the canal was never fully completed. The proper piers extending out into the Bete Grise bay were not constructed and soon the channel became choked up with sand so that vessels could no longer enter, and the harbor ceased to be used. If the harbor were rendered available it would be of great value to the commerce of the lake, since vessels could enter with safety in all weather; and now there is no port of any description between Portage Entry and Copper Harbor.

When the mines situated south of the greenstone, in Keweenaw county, shall have become sufficiently prosperous to render the proposed railroad a necessary adjunct, both its construction and the improvement of Lac La Belle harbor will be accomplished.

ST. CLAIR MINING COMPANY.

The St. Clair Mining Company owns the S. E. ¼ of N. W. ¼, and 30 rods wide off west side of the E. ½ of Sec. 29, and a strip 33 rods wide off from the east side of the S. W. ¼ of Sec. 29, all in T. 58, R. 31, 133 acres, and adjoins the Phœnix on the west and the Eagle River Company on the east.

The mine is opened on a transverse fissure vein, which bears north about 20° W., and has an average width of about 18 inches. The shafts are upon the south-

erly slope of the greenstone bluff, which here, as elsewhere along the range east from the cliff, has a more gradual descent. At the working shaft are a hoisting engine and rock crusher, whence the rock drops down a shute into cars in which it is trammed to the stamp mill, situated a short distance to the south at the foot of the bluff. The water comes from a pond, about 600 feet to the southeast of the mill, brought in a launder. A second pond is made by a dam close to the mill.

The company was originally formed in 1863, and the mine was worked to the depth of 300 feet. Four levels were drifted, a small product in mass copper and barrel-work were annually obtained, and in 1872 the stamp mill, containing twelve head of stamps, with wash-house, was put up, but was not used, as about the time it was finished the panic occurred and the work was suspended. The property then went into the hands of the creditors, who held it until the winter of 1879–80 and organized a new company with capital stock of $1,000,000, and assessed 37½ cents per share and began work in the old mine. About eighteen miners are employed and a fair amount of small masses and barrel-work is being got out. In addition to the improvements above stated there are fifteen houses on the location.

A shaft was formerly sunk 600 feet to the east on a vein, but it was not thought to have looked very favorable. The work is in charge of Mr. Delano, agent of the Phœnix Copper Company.

Office in Boston. John Brooks, Secretary and Treasurer.

CENTRAL MINING COMPANY.

In the early period of mining on Lake Superior the wonderful occurrence of the great masses that were found in such quantity at the Cliff mine stimulated mining enterprise in an extraordinary degree, and concentrated the attention of explorers and of investors in mining stocks to endeavor to find and to develop similar veins. The search was not in vain, nor the opportunity wanting; the great greenstone range that extends the length of Keweenaw county afforded innumerable fissures, traversing its formation, that apparently seemed equally favorable to the existence of the ponderous masses which the great bonanza continued to yield. But barely one among the scores of the mines that have been opened in this region since the discovery of the Cliff has proved to be a source of revenue and profit to its owners. The hundreds of shafts that have been sunk have, unfortunately, rather become receptacles for burying treasure instead of avenues through which it should flow out. And why the many veins should be comparatively barren and the limited few so enormously productive is a problem that is far from being satisfactorily solved. The owners of the Winthrop, the Northwestern, the Dana, the Northwest, and of many other locations in like situations, had perhaps as much reason to expect a favorable result to their undertakings as did the proprietors of the Central. It illustrates the uncertainty of mining enterprises. The hope is sustained by faith in what may be hidden from view. The few rich veins which have been found establishes the fact that such do exist, and it is the expectation of discovering such a store of wealth that stimulates to ever renewed search and expenditure.

The Central mine, which has proved to be one of the most valuable deposits of mineral that has been discovered in Lake Superior, comprises the E. ½ of Sec. 23, T. 58, R. 30, situate between the Winthrop on the west and the Northwestern on the east. The location lies well up on the bluff, so that the greenstone formation passes east and west through the north half of it at an elevation of 700 feet above the lake. The descent to the south is steep, but

sufficiently gradual for convenient mining work. It is distant, by good road, about four and a half miles southwest from Eagle Harbor, and is supplied with water by the east branch of the Eagle river, which runs along the foot of the bluff, westerly, through the property.

The greenstone and the alternating beds of granular and amygdaloidal trap which lie to the south of it have been, as at the other mining locations, heretofore described, situated on the south side of the greenstone range, a uniform dip to the north of 25°. The vein, a vertical fissure, running at right angles with the formation, with an average width of about 20 inches, was first discovered in the summer of 1854 by Mr. John Slawson, agent of the Cliff mine, at a point about 600 feet to the south of the greenstone. Here an ancient excavation was opened by a party of men under charge of John Robingson, and in it was found a mass of pure copper in a well defined vein bearing to the northwest. Further opening of this vein developed the existence of copper in unusual quantity.

Immediately after Slawson's discovery, however, and previous to the developments made by Robingson and his party, the property had been purchased by some Lake Superior men, residents in the vicinity. In November the first shaft was begun at a point 70 feet north of the mass of copper found in the ancient excavation, and on the 15th of the same month the company was organized, the board of directors, consisting of S. W. Hill, John Slawson, A. A. Bennett, John Robingson, and Waterman Palmer, duly elected, and an assessment of ten cents per share voted to be raised.

Water proving too troublesome to carry forward the work of sinking, an adit was made to secure drainage, and the shaft was continued down 53 feet below it, disclosing the existence of a large amount of copper. The use of the buildings and other improvements at the Winthrop mine was secured and the services of A. A. Bennett as agent were engaged for the ensuing year.

In the year succeeding the first discovery of the vein there was taken from it 84½ tons of mineral, which yielded 80 per cent of pure copper. Up to this time—July 1, 1855—including every item of expense and of liability, the expenditures were $29,711.29, which sum was exceeded by the value of the product $7,251.07—the first instance of a mine being opened in the Lake Superior district which produced and sold during the first year of its operations copper enough to more than pay all the expenses of the company.

During this year the mining work done consisted in sinking No. 1 shaft to the depth of 156 feet and a second shaft, No. 2, to the depth of 105 feet, and in opening a gallery 525 feet in length in the 10-fathom level and one 63 feet in the 20-fathom level, and in addition to the above an adit 153 feet in length for draining. The surface improvements were three houses and a horse whim.

The average cost for smelting the copper in Detroit was $18.32 per ton. In the meantime the controlling interest had passed into the hands of the owners of the Cliff, and in the second board of directors, elected July, 1856, are found the names of C. G. Hussey, Thomas M. Howe, James M. Cooper, John Slawson, Waterman Palmer, William Bagley, and A. A. Bennett. The business office was removed from Eagle Harbor to Pittsburg. Dr. C. G. Hussey was made President and Waterman Palmer Secretary and Treasurer. These gentlemen continued to control the mine until 1859, when a majority of the stock having been purchased by New York men, a new board of directors was elected, with Jordan L. Mott, President, and James M. Mills, Secretary and Treasurer, and the office was removed to New York. Up to this time but little

surface improvement had been made; houses and other buildings had been rented of the Winthrop and the Northwestern, and these were sufficiently accessible for the purposes of the Central. The Northwestern stamp mill had also been used at an annual rent of $2,000, so that but a small portion of the receipts had been diverted from sustaining mining work.

Up to 1860 the sale of the copper produced from the mine had brought the total sum of $156,000, and the total assessments amounted to $47,000, of which $34,000 were accounted for in the assets. The total expenditures had been $203,000, leaving but $13,000 for dead work, which sum the drainage adit, 1,600 feet in length, would much more than account for. The mine had been opened with caution, the stoping ground was but little in advance. Four shafts were down to the 20-fathom level, and the levels opened to connect the shafts, the whole work having been done with but little cost to the stockholders. The product for 1857 was 105 tons, 487 pounds.

The new board determined on the construction of a stamp mill, which was not completed, however, until 1861. It was also determined to push forward the mining work more vigorously and open a large amount of ground as rapidly as possible. The product for 1859 was 172 599-2000 tons, yielding 70⅛ per cent ingot=120 1622-2000 tons refined copper, which sold at 22½ cents per pound; product for 1860, 81 1558-2000 tons, yielding 72.67 per cent; for 1861, 204 5-2000 tons of 79.1 per cent purity. The low price to which copper fell on the breaking out of the war,—17½ cents per pound,—and the apprehension of assessments, caused the Central stock, in common with many others, to fall to a very low price. The purchase of additional machinery, building of a stamp mill, and other contemplated improvements, were necessarily deferred, and the officers of the mine were enjoined to keep the expenditures within the value of the product. In 1862 the price of copper had so advanced, and the product of the mine had so greatly increased, that the directors were enabled to begin to carry out the plan which the managers had previously determined on, and many needed improvements were made. The additions included twenty new houses, a new pumping and hoisting engine with hoisting machinery and pumps, sixteen additional stamp heads, and additional machinery to run them, and also two rock breakers.

The product for the year 1862 was 304 1132-2000 tons, yielding 79.58 per cent=242 764-2000 tons of refined copper, which sold for an average price of 36¾ cents per pound. The stoping cost $24.70 per fathom; the sinking of shafts and winzes, per foot average, $17.22; the drifting, per foot, $7.84; number of miners employed 69, and the average contract wages per month, $36.51; average price per month for surface men, $29.95; for stamp mill men, $27.32.

No. 4 shaft was sunk at the south edge of the greenstone, and as increased depth was attained and the levels were extended northward under the formation, the same trouble began to be experienced as was felt in all the mines working under the greenstone that had got to a sufficient depth.

It was decided at the Central that instead of sinking vertically from the top of the bluff, as had been done at the Cliff, an incline shaft could be more cheaply constructed, and that the subsequent cost of operating would also be less, and the convenience would be greater. A vertical shaft from the top of the bluff to the north would bring the rock to the surface at greater distance from the stamp mill, increasing the cost for surface tramming. Accordingly a double track inclined shaft was begun in 1863 from the surface at about mid-

way between No. 3 and No. 4 shafts. It was carried down in the vein with an inclination to the north, conforming to the dip of the greenstone. Considerable surface improvements were made during the year, rendered necessary from the fact that the company was no longer able to use the buildings of the Northwestern Company. In this work the sum of $44,000 was expended. A purchase of a large body of land was made, consisting of 7,000 acres, for the timber, it having been found to be almost impossible to obtain the timber and the wood necessary for the purposes of the mine.

The product for the year was 805,545 pounds of mineral, yielding 76.87 per cent=619,268 pounds of ingot, which sold at an average price of 34 3-10 cents per pound. Out of the proceeds the company paid its first dividend of $2.50 per share, and from that year forward it has never passed its annual dividend. A serious fire occurred at the mine destroying the engine house and shaft house and doing much other damage, and as mechanics were very scarce in the country at that time, a good deal of delay was thereby encountered.

The deepest shaft was down 520 feet; the total depth of shafts was 1,594 feet; and the total amount of drifting done was 8,206 feet. The cost for mining work for the year was, for stoping, per cubic fathom, $24.36. The cost per foot for sinking was $21.83, and the cost per foot for drifting was $9.58. The average yield of mineral per cubic fathom was 724 pounds, an increase of 53 pounds per fathom over the previous year. The average number of miners employed for the year was 93, and their average rate of wages was $48.55 per month. The total mining force was 207. Some extraordinary large masses were found.

Additional improvements were made in 1864–65. Houses were built, machinery added, a dock at Eagle Harbor built, the stamp mill enlarged and the number of stamps increased to 32 heads; but the water was found to be greatly insufficient. Dividends of $2.50 per share were made each year. The product for 1864 was 502 877-2000 tons, yielding 77.55 per cent; 1865 the product was 802 778-2000 tons, yielding 77 per cent=713 1659-2000 pounds, two-thirds of which was mass copper. The yield per fathom of ground was 849 pounds. The product sold at an average price of 32.78 cents per pound; the highest 40 cents and the lowest 28 cents.

During 1864 and 1865 copper mining labored under great disadvantage, since, owing to the high price at which copper had sold in the previous year, wages had become correspondingly high, as had also materials. The mines found it impossible to reduce the price of labor, which was scarce, and mining materials, to conform to the reduction in price of copper. Very much was therefore produced at a cost exceeding its value. Nevertheless the company was enabled to declare a dividend of $50,000 in 1866.

No. 2 and No. 4 shafts were straightened and furnished with guides and skips. The production of copper for the year 1866 was 876 1160-2000 tons, which yielded 79.44 per cent of refined copper. The product was equally divided between mass copper and stamp rock. The percentage obtained from the stamp rock was 2=40 pounds per ton of rock. The cost of stamping, washing, etc., was $1.10½ per ton of rock; cost of labor for tramming, breaking the rock ready for the stamps was 21.13 cents per ton. Total number of men employed at mine in 1866 was 267, of whom 191 were miners, who received an average price of $56.32 per month. The surface men received $49; stamp mill men $43 per month, average. The inclined shaft was completed to the 20-fathom level and provided with a double track 335 feet from the surface.

In 1867 the directors declared a dividend of $2 per share. The product for the year was 783 859-2000 tons, yielding 79.39 per cent = 1,244,441 pounds refined copper, which sold at an average price of 24¾ cents per pound.

The yield of mineral per fathom of ground was 510 pounds ingot copper. The rock yielded 2.41 per cent mineral, and cost 93 cents per ton of rock for stamping and washing. The proportion of mass and stamp rock were about equal. In the stamp copper is included the barrel-work. The company also operated a saw-mill.

In 1870 the mine produced 873 1737-2000 tons of mineral, yielding 76.37 per cent of ingot = 1,327,156 pounds refined copper, which sold at an average price of 20.47 cents per pound. A dividend of $70,000 was paid in 1869 and $80,000 in 1870. The average yield of mineral per fathom of ground broken was 601 pounds of mineral = 464 pounds of ingot copper. The stamp rock yielded 2.99 per cent mineral; number of tons of rock stamped per cord of wood consumed was 10 65-100; number of tons of rock stamped per stamp head per 24 hours, 4 22-100; total cost of stamping and washing per ton of rock, 81.22 cents; total cost for labor in tramming and breaking per ton of rock, 15.44 cents; average number of miners employed, 167, at an average price per month of $50.55. The population at the mine amounted to 950, and the number of pupils in the school was 200. At this time the aggregate length of the shafts was 3,492 feet, and the total length of the levels was 20,504 feet. The yield of the mine in masses amounted for the year to but little more than one-half of the yield of the stamp work.

In 1871 the amount of copper shipped was 922 575-2000 tons, yielding 77.669 per cent = 1,432,662 pounds ingot copper, which sold at an average price per pound of 22.66 cents, out of which the company paid its annual dividend of $50,000.

In 1872 the mine produced 863 1123-2000 tons of mineral, which smelted yielded 77.14 per cent = 1,331,610 pounds refined copper, which sold at an average price of 30 43-100 cents per pound. The net earnings were largely in excess of previous years, owing to the high price of copper and the low scale of the company's expenditures. Out of the surplus a dividend was declared of $80,000. The number of tons of rock stamped during the year was 18,942, yielding 2.87 per cent of mineral; amount of rock stamped per head of stamp in 24 hours was 4 31-100 tons; amount of rock stamped per cord of wood in 24 hours was 10 13-100; cost of labor for breaking, tramming rock to the stamp mill was 14.96 cents per ton; total number of men employed in 1872 was 223, of whom 149 were miners. The inclined shaft was completed down to the 100-fathom level.

Some trouble was experienced in the copper region in 1872 with the miners, culminating in strikes and exciting a feeling of uneasiness in all classes. Governor Bagley ordered the State troops from Detroit into the copper districts. But there were no outbreaks, no serious acts of lawlessness beyond the power of the local authorities to control. The miners shifted frequently from one locality to another, to the great detriment of themselves and of their employers and to the disturbance of the peace of the country.

The general expenditures to date were $2,958,132.22; the total sales of copper were $3,904,496.51; the average cost for sinking shafts and winzes was $24.86 per running fathom; the average cost for drifting levels was $13.16 per running fathom; the average cost for stoping per cubic fathom was $18.71; the average yield in mineral per cubic fathom was 614 pounds = 473 pounds refined copper. The total depth of shafts was 4,180 feet; total length of levels

was 22,979 feet. The total cost per ton for breaking and tramming to mill was 14 86-100 cents; the cost per ton for stamping and washing was 98 34-100 cents. The average wages for miners was $61.88 per month; the average wages for surface men was $48.54 per month, 35 men employed; the average wages for stamp mill men was $47.72, of whom there were 18.

The increased depth of the mine rendered it necessary to procure machinery of greater power, as the work to be performed had outgrown the power of the engines then in use, to fulfill the requirements. Accordingly, in 1875 a powerful hoisting engine, horizontal, with two 24-inch cylinders, four feet stroke, was erected, together with two adequate winding drums for working No. 2 and No. 4 shafts. The engine house is of stone, 50x60 feet, with steam boiler house attached, very substantially built. A new engine for pumping and for working the main engine shaft was also procured, 18-inch cylinder, 8 feet stroke. In addition to the above improvements, fourteen new dwelling houses were built. But notwithstanding all this expenditure, a dividend of $5 per share was declared. The product for the year was 1,466,952 pounds of ingot copper, being 70.82 per cent of the mineral product, which sold for 22.56 cents per pound.

A belt of conglomerate was intersected in the 150-fathom level, but it did not prove to be as productive of copper as at first was anticipated. The general expenditures to January 1, 1875, was $3,741,262.42. The total dividend paid to that date was $1,200,000. Two hundred and twenty feet of sinking done, which cost $32.88 per foot; 1015 feet of drifting done, which cost $12.07 per foot.

The average number of pounds of mineral per fathom was 746 = 528 pounds ingot copper. Number of tons of rock treated in the stamp mill, 17,118, yielding 3.78 per cent of mineral. The cost for tramming and breaking, 15.33 cents per ton of rock; cost for stamping and washing, $1.00 per ton. Average number of miners, 138; wages per month, $52.65. Surface and stamp mill men, 54; average wages, $44.

Total depth of shafts, 4,695 feet; total length of the levels, 26,104 feet.

In 1876 the product was 1,403 183-2000 tons, yielding 71.22 per cent = 2,161,400 pounds of ingot copper, for which was realized the sum of 20.86 cents per pound. The general expenditures to that date were $4,016,827.71; the total receipts from the sales of copper were $5,487,313.51; a dividend of $7 per share was declared. The total length of shafts was 4,856 feet; of levels, 27,137 feet. The cost of sinking was $32.84 per foot; for driftings in vein, $12.41; in conglomerate belt, $16.23 per foot; cost of stoping per fathom, $20; yield of mineral per fathom, 863 pounds = 614 pounds ingot copper. Total number of tons of rock stamped, 12,658; yield per cent, 5 3-100 of mineral; cost of breaking and tramming to mill, 15.88 cents per ton; stamping and washing per ton, $1.02; number of miners employed, 184; average wages paid, $49.80; number of surface and stamp men, 50; average wages paid, $45; the expenditures for the year were $280,060.46; the receipts for the year were $425,026.46; the profit for the year was $144,966.

It had been contemplated for some years to provide a man engine for convenience and safety in ascending and descending in the mine; accordingly, No. 4 shaft was furnished with one.

In 1877 the product of the mine was 1,408 862-2000 tons, which yielded 71.39 per cent = 1,995,609 pounds of ingot copper, for which was realized the sum of 18.36 cents per pound = $368,644.33. The expenses for the year were $216,882.39, leaving a profit of $105,297.01; $13,385.96 were expended in the man engine, and a dividend of $5 per share was declared. The

total expenditures to date amounted to $4,270,017.41, and the total receipts were $5,853,745.15. The total length of shafts, 5,018½ feet; of levels, 28,857 feet; number of tons of rock stamped, 14,119, yielding 4.21 per cent of mineral; cost of breaking and tramming per ton of rock, 14.85 cents; cost of stamping and working per ton of rock, 82 cents; number of miners employed, 195; average wages paid, $49.80 per month; number of other employés, 47; average wages paid, $43.50 per month. The average cost per foot for sinking was $33.60; the average cost per foot for drifting was $10.50; the average cost per fathom for stoping was $18.61 in the vein, and $20.73 in the conglomerate. The stoping in the conglomerate extended east and west; average yield of mineral per fathom of ground stoped, 862 pounds = 615 pounds of ingot copper. No. 4 shaft was timbered to the 170 fathoms level, and fitted with a skip road, and No. 2 shaft was finished down to 180th level.

In 1878 the product of the mine was 1,358 1112-2000 tons, which yielded 71 per cent of ingot = 1,891,013 pounds ingot, for which was realized the sum of 15.84 cents per pound; a dividend of $4 per share was paid. The total expenditures to date were $4,541,087.57, and the sales of copper amounted to $6,153,735.05; the number of tons of rock stamped during the year was 13,858, yielding 3.65 per cent of mineral; total cost of stamping and washing per ton of rock, 69.70 cents; cost of breaking and tramming per ton, 10 cents; average cost of sinking per foot, $32.22; average cost of drifting per foot, $10.25; average cost of stoping per fathom, $25; yield of mineral per fathom, 1,001 pounds = 711 pounds of ingot; average number of miners employed was 179; average wages, $45.67 per month; average number of other employés was 45; average wages $38.10 per month. There was a less number of men employed than in the previous year, and a less product obtained. The conglomerate belt yielded well for a short distance, but did not continue to hold up.

The Madison mine was sold at sheriff's sale and bought by the Central company, but the property was redeemed the following year.

The product of the mine in 1879 was 1,198 1088-2000 tons, yielding 75 per cent = 1,799,495 pounds of refined copper, which sold at an average price of 15½ cents per pound = $278,892.54; receipts for silver sold, $672.03; total sales, $279,564.57.

The net surplus January 1, 1880, was $332,200.34, out of which a dividend of $5 per share was declared. There was a slight falling off in the product owing to the occurrence of unusually large masses, requiring increased labor and time in cutting them up.

The total receipts to January 1, 1880, were $6,543,531.72; the total dividends, including the dividends declared, $1,440,000; the total capital advanced by stockholders, $100,000. The product embraced 289 masses, weighing 1,038,497 pounds; stamp work, 829,205 pounds; kiln work, 455,340 pounds. Average cost per foot for sinking, $35.23; average cost per foot for drifting, $11.26 in vein; average cost per foot for drifting, $12.74 in conglomerate; average cost per fathom for stoping, $18.57 in vein; average cost per fathom for stoping, $27.51 in conglomerate; total amount of ground in mine, 2,537 fathoms; the average yield of mineral per fathom of ground was 915 pounds = 686 pounds of refined copper; the number of tons of rock stamped was 12,478; the yield of rock in mineral was 3.32 per cent = 2.49 per cent ingot; cost of stamping and washing per ton was 64.27 cents; number of tons stamped per head each 24 hours, running time, 5.49; number of tons

stamped per cord of wood consumed, 10.79; cost per ton for breaking, selecting and tramming to mill, 10.69 cents. Number of miners employed, average 168; average wages paid, $47.05; number of surface men employed, 33; average wages paid, $35.63; number of stamp men employed, 10; average wages paid, $36.00. Total length of shafts was 5,419 feet; of levels, 31,571 feet.

The conglomerate belt proves to be well charged with copper to a distance of from 15 to 25 feet either way from the vein, and then it becomes poor. Eighteen men were employed in the 19th level in cutting up a 300-ton mass, and another was found thought to be equally as large.

Mr. C. B. Petrie, who had been agent since 1859 resigned his position and was succeeded by Capt. James Dunstan, who had been mining captain since 1866. Capt. Dunstan's predecessor in charge of the mine was Capt. William Tonkin, the present efficient agent of the Atlantic mine.

The general expenditures of the company to January 1, 1881, including stock on hand, bills receivable, dividends paid, etc., amounts to the sum of $6,932,347.25; the total of sales of copper and silver to the same date amounts to $6,806,249.82; sales of copper in 1880, $242,530.38; value of amount on hand, $129,584.70. Silver produced in 1880, $835.12. Total value of product for 1880, $372,950.20. The total assets of the company are placed at $640,593.77, exclusive of the real estate comprised in the mining location; the available assets are $355,094.45. Total liabilities, including balance of assets ($355,094.45) = $398,669.55.

The production of mineral for 1880 was 1,271.560 tons, and the quantity smelted was 1,321 1220-2000 tons = 76.6 per cent.

A dividend of $3 per share ($60,000) was paid in February, 1881, and a further dividend will be paid to the stockholders from the profits of the year's business as soon as the copper now on hand shall be sold.

The product was divided as follows: 733 barrels, weighing 899,977 pounds; 127 hhds. kiln, weighing 387,682 pounds; 286 masses, weighing 1,254,901 pounds; total, 2,542,560 pounds.

The average yield of mineral per fathom of ground broken was 778 pounds. The average yield of copper per fathom of ground broken was 596 pounds. The total amount of ground in openings and stopes was 3,267 fathoms. The average cost of sinking in shafts and in winzes was, per foot, $27.58. The average cost of drifting was, per foot, $12.78. The average cost of stoping on vein, per cubic fathom, was $40.00.

The total number of tons of rock stamped was 14,520. The yield of rock in mineral was 3.09 per cent; yield of rock in ingot was 2.37 per cent. Cost of stamping and washing, per ton, was 72.25 cents. Rock stamped, per head, in 24 hours, running time, was 4 4-5 tons. Rock stamped and washed per cord of wood consumed, 11.22 tons. The cost per ton for breaking and selecting rock, and tramming it to mill, was 11.20 cents.

Considerable increased outlay, due to repairs which were made, have made the expenses at the stamp mill greater than they were the preceding year. The force employed consisted of 179 miners, who received average wages of $56.79 per month; 36 surface men, who received average wages of $42.27 per month; 10 stamp mill men, who received average wages of $46.33 per month. The number of men now employed at the mine is 243. It has been necessary during the past year to make an unusually large expenditure for repairs and additions to machinery and buildings.

The building in which the pumping engine was placed having become unsafe was taken down, and a new stone building erected in its stead, without interfering with the working of the machinery.

The hoisting is done in No. 4 and in No. 2 shafts; the former is fitted with a skip road down to the 200-fathom level, and is also furnished with the man engine; the latter is fitted for hoisting the heavy masses in addition to general hoisting work, and is also the one through which the water is pumped. Nos. 1 and 3, and the inclined shaft are not used. The longitudinal section of the mine shows the working of the mine to the present time, and the position of the amygdaloid and conglomerate beds, etc. A geological examination of this mine was made by Prof. Pumpelly, and a scientific description with an accompanying map will be found in his report of the geology of the Lake Superior copper region for the State of Michigan, 1873.

The mine has now attained a depth, vertically from the surface, of 1,700 feet, and the mine continues to look well, and to yield bountifully. The future of the Central will be regarded with increased interest, from the fact that the theory prevails, based upon the apparent failure of the Cliff, Minesota, and National mines, that fissure veins will not continue productive to any great depth. Whether this opinion be sound or erroneous, it is a fact that the Central has already attained to a greater depth than was reached by either of the mines above mentioned, and still continues to yield up its ponderous masses as freely as at any period in its history. The Central justly bears the reputation of being a carefully and conservatively managed company. The location shows that everything has been done with reference to use and permanency, but nothing for show. A double track incline, laid on elevated trestle, connects the shafts with the stamps.

There are 130 dwelling houses on the location, all of which are occupied, and much want is felt for a greater number. The population is about 1,200. In addition to the usual mining force, about 90 men are now employed in cutting and hauling the year's supply of wood for the mine. The company have built a fine school building, and a well graded school is maintained.

The officers of the company are: Geo. A. Hoyet, President; John Stanton, Jr., Secretary and Treasurer; office, 76 Wall street, New York. Officers at the mine: James Dunstan, Agent; Samuel Bennett, Mining Capt; J. F. Roberts, Clerk.

THE ONTONAGON DISTRICT.

Mining work in the Ontonagon district was carried on cotemporaneously with work upon Keweenaw point, and in both it had attained to considerable importance, and become widely known before any mines had been opened on Portage lake, or that region was claimed to possess any great degree of mineral value.

The prospectuses of early mining enterprises in the Keweenaw district, inviting the attention of capitalists and of investors in mining stocks, to the probable value of the shares, which were offered, were not unfrequently embellished with a display of the profitable results obtained at the Cliff, and in Ontonagon the fame of the great Minesota proved to be a force equally attractive and potent.

The remarkable results of these two mines established the reputation of the districts to which they respectively belonged. However frequent and great might be the failures at other locations, the profits which these mines yielded

were certain facts, and demonstrated the great wealth of at least a portion of the cupriferous deposits of the country; and this knowledge undoubtedly sustained the flagging hopes in many a forlorn mining enterprise, and stimulated to renewed endeavor to achieve success at many less promising mines.

The geographical division of the copper region of Lake Superior into three districts is borne out and sustained by the distinct character of the metalliferous deposits, which occur in the different districts. In Keweenaw county, as has been described, the copper is found mainly in fissure veins, which cross the formation at nearly right angles to its course, and in the ash bed on the north, which runs with the formation, and conforms to it in dip.

In the Portage Lake district the copper is found in regular beds that have a well defined course upon the surface, wherever observed, and which may be clearly determined in the underground workings. In these beds, which are either amygdaloid or conglomerate, the copper is found to be distributed with considerable uniformity, though frequently in a small percentage, but it is not found to occur, to any great degree, in large masses.

In Ontonagon county the copper occurs in veins and in belts, which run with the formation. The copper-bearing veins, while conforming in direction with the strike of the inclosing rock, frequently dip at a greater angle, but always in the same direction. The beds which have been mined for copper are frequently distinguished by their irregularity, rendering it extremely difficult or impossible to define them. The product, which has been mainly in the form of masses, is in some portions of the range found scattered in the trap rock in a manner that sets at defiance any method of determining their location other than mere chance; blind, persistent work may lead to the discovery of an isolated mass or of a collection or a succession of masses, but it is frequently blind luck, and not the result of following any well defined clues. In many of the mining locations in Ontonagon county copper really exists in a good degree of abundance, and were it concentrated into a vein, would form a mine well worth working, but it is scattered so promiscuously that to obtain it, a system of mining, which partakes of the nature of irregular excavation, has been to a great extent practiced. In some instances, in the Evergreen Range, where the copper is really confined to a vein, the deposit appears as if it had been originally a rough irregular seam that became filled up with boulders of trap and the usual vein matter, among which is scattered the particles and masses of copper. These boulders are frequently so large as to form great "horses" in the vein.

Transverse fissures occur, but never contain copper or the vein matter that is associated with the occurrence of copper, as in Keweenaw county: they become here only cross-courses or slides filled with clayey matter and soft rock. These cross courses are generally selected as points in which to drive in adits from the north or south side of the bluff, crossing the lode at right angles.

In the Porcupine mountains the copper-bearing beds occur between the trap and the sandstone, having the latter for a foot wall, and at the Nonesuch mine, in this portion of the range, the hanging wall becomes a so-called slate.

The first great impetus given to the mining interest in this county was through the discovery of the Minesota mine in 1847 by Mr. S. O. Knapp. He was led to the discovery by examining the indentations, which were plainly discernable along the surface outcrop of the vein, and which proved to be ancient mining excavations. This was the first discovery of the "Indian diggings," which have since been found to exist everywhere in the copper region. One of

the principal pits opened by Mr. Knapp was found to have penetrated the vein to a depth of 27 feet, and was filled up with an accumulation of dirt and partially decayed vegetation; but at 18 feet from the surface a mass of nearly pure copper was found, weighing upwards of six tons. This mass had been raised from its original bed, a distance of five feet, and secured there on timbers, which had been placed under it. The timbers, however, had decayed, and the mass remained in its place, supported by the soil, which had imbedded itself around it. The mass had been hammered all over until its surface was entirely smooth and the adhering gangue, or rock crystals, was almost wholly removed. In this pit, as in others when cleared of the rubbish which filled them, was found great numbers of stone hammers, bits of burnt wood, a copper chisel with a socket for holding a handle, etc. Directly over this mass, deriving its support from the soil and debris which nearly filled the pit, stood a hemlock, which showed, when cut, 325 distinct annual rings of growth; and this was standing by the side of a much larger stump of a tree that had grown up and gone to decay since this pit had been excavated, and the mass of copper found beneath its roots had been raised from its bed, and the brands which were found beneath it had been burned, and the long period of time had elapsed necessary for the accumulation of the soil that filled the pit and supported the organic growth.

The rich promise afforded by the discovery of this mass of copper was greatly increased by the speedy results which further explorations immediately developed, and was subsequently in the highest measure fulfilled in the abounding prosperity of the company.

Four years later the National Mining Company began its prosperous career, and opened its mine on the adjoining location. These two companies, among the most profitable mining enterprises ever organized on Lake Superior, gave to the Ontonagon mineral district a wide celebrity, and for nearly twenty years it enjoyed a comparatively high degree of material prosperity. The remarkable success of the Minesota and of the National stimulated mining enterprise in this district, and innumerable companies were formed, some of which prosecuted mining work with considerable zeal and with lavish expenditure, but, unfortunately, at little profit. During the past two years comparatively but little mining has been done, and Ontonagon has become almost a synonym in the copper region for stagnation; but recently there are many indications denoting a probable revival of its business prosperity.

In the early days of mining in this region the vessels which brought the supplies and necessary materials and bore away the product were obliged to stop outside the bar, which formed across the mouth of the river, and to load and unload by aid of lighters. Much of the freighting with the mines was accomplished in flat boats that were propelled up the river ten or twelve miles to the "Minesota landing." But the water was too shallow and flowed with too strong a current in some portions of the bed, and the occurrence of rocks was too frequent to render this channel a desirable avenue for accomplishing the necessary transportation. The necessity for better facilities for carrying to and from the mines led to the construction of a plank road thirteen miles to Ontonagon village, and subsequently to the building of another plank road, which connected the Rowland mines—those in the eastern part of the county—also with the harbor at Ontonagon.

The want of a better harbor also began to be seriously felt, and the first work of improvement of Ontonagon harbor was undertaken by Mr. Charles T. Har-

vey of New York, who had superintended the building of the ship canal at the Sault de Ste Marie in 1856, under a contract with the county board and with the mining companies, by which Mr. Harvey was to receive a certain compensation while the work was progressing and to be entitled to a certain royalty or toll on all copper shipped. The contract was never completed, and the work which was done proved of but little permanent value. The matter was brought to the attention of the general government, and in 1866 an appropriation was made by Congress for the purpose of improving this harbor, and in the following year the first crib was sunk, since which time the piers have been extended 2,100 feet, through the expenditure of successive appropriations, amounting in all to the sum of $200,000.

As a result of this important improvement, steamers can now enter the harbor without difficulty and unload at the docks, instead of as formerly stopping outside and transferring by lighters. The intention is to continue the extension of the piers into water of sufficient depth to prevent the filling up of the channel by the deposits of sand. The river carries a considerable volume of water, and it is thought that by the aid of dredging it can be rendered sufficiently deep to enable vessels to pass to some distance up the stream.

The principal claim heretofore set forth by the petitioners for appropriations has been the importance of the harbor as a place of refuge, since the amount of freight which for some years has been received at and sent away from this port has hardly been of a sufficient magnitude to justify a claim for a large appropriation; but in future when it shall have become a railroad terminus, and the valuable forests of pine and other timber which are naturally tributary to it are brought into requisition; when the rich farming lands of the county shall be cleared and cultivated, and its great mineral interests shall again revive and flourish, then the business of the harbor must sufficiently increase to render it one of the most important of the lake, and thus occasion the demand for expenditure that shall suffice to make it as complete as possible.

An important advantage in the harbor of Ontonagon arises from the fact of its remaining open in the fall and winter long after nearly all the ports on the south shore of Lake Superior are closed with ice. At the present writing, December 1st, Ashland, Bayfield, Portage Lake, L'Anse, etc., are completely shut, but here at Ontonagon a vessel could freely enter and lay at the dock.

The county of Ontonagon comprises a total area of upwards of 1,500,000 acres of land, and undoubtedly possesses natural advantages and resources which are surpassed by few counties in the State. Situated at the western extremity of the Upper Peninsula, it is at present, with the exception of Isle Royal, perhaps the most isolated county in the State. The only road suitable for summer travel which penetrates its borders is one along the Mineral Range from Houghton. A county road is building from the western terminus of the Marquette, Houghton & Ontonagon Railroad at L'Anse westward a distance of thirty-five miles to Greenland. This road has been completed from the L'Anse end nearly one-half the way, and in the winter, during the period of sleighing, a daily stage carrying the Ontonagon county mail passes over the entire route; but in summer, the mail is now carried from L'Anse to the end of the wagon road with a team, and then for the remainder of the distance it is packed through by an Indian.

Travelers from the East must reach Ontonagon by boat; or, if desirous of exercise, may depend upon their perambulatory powers to bring them through. In these days of walking matches, such an attempt might, on occasion, per-

haps, be putting to a practical use one's ability in this direction, and in a way he would be likely to appreciate before he got through, and possibly have good reasons for remembering for some time afterwards.

The supplies for the mining district of the county are brought in by boat to Ontonagon, and are thence hauled in wagons over many miles of rough roads to the several locations; and in case of navigation closing before the necessary supplies have been got in, they must be sent to L'Anse by rail, and thence hauled through the woods with teams. Such an alternative occurs the present season. A large portion of the supplies were sent to Ashland and to Duluth to be brought into Ontonagon, and into Portage Lake by boat; but unfortunately the advent of unusually early severe weather closed the harbor of Ashland and the Portage Lake canal before the freight at Ashland and at Duluth had been got away. So that country is thus compelled to bring a great portion of its winter supply of provisions and materials around by rail to L'Anse, at a greatly increased cost. The hauling by sleigh with teams from L'Anse through to the Ontonagon mines costs for freight one dollar per hundred, and passenger travel five dollars per individual.

The mines of this county labor under the disadvantage of being obliged to haul all their product and supplies, or whatever materials, a dozen miles or upwards, to or from Ontonagon harbor, and also of generally possessing an insufficient amount of water for the purposes of stamping and washing their rock. These drawbacks cannot be regarded as permanent obstacles, since when a railroad is in operation between the mineral range and the harbor, they can be effectually removed.

It is easy to understand how, that a region so isolated and inaccessible, without railroad or telegraphic communication, combined with a rigorous climate, should be slow of settlement. And yet, to offset its many and serious obstacles to improvement, the country possesses resources and advantages that must ultimately secure to it a great degree of prosperity. The mineral range, which starts from the northern extremity of the Keweenaw peninsula, and runs southerly, parallel with the coast line, through Keweenaw and Houghton counties, extends beyond the southern limit of Ontonagon; and if the Minesota and the National be taken as an index, and the not unreasonable hope of the revival of these great mines to a productive capacity approximating to their past be entertained, or the future discovery of productive lodes, such as these have been, be accepted as the basis of conjecture, there are certainly grounds for the hope, which the most confident may entertain, of the future mining prosperity of the county.

The indications of the existence of valuable deposits of iron ores, which are found in the southern and southwestern part of the county, may become, at no distant day, the basis of prosperous industry in iron mining.

But aside from its mineral resources, which here, as elsewhere, must always be, in a degree, speculative and intangible, this portion of our State is exceedingly valuable for its timber and for its soil. There are large areas of excellent pine land, which are as yet untouched, and which will afford millions of feet annually for many years to come, while the great forests of birdseye, yellow birch, cedar, etc., must at least possess an equal value and be in demand for manufacturing purposes, when suitable facilities for transportation shall render them available.

Off the mineral range the country is comparatively level; very much of it is gently rolling, hard wood land, which is well watered by frequently occurring

streams and lakes. Of these the Ontonagon river and Lake Agogebic are the largest. The latter is a lake about 15 miles in length and two miles in breadth, and is situated in the center of the county, in the midst of beautiful hard-wood forests which surround it and fringe its borders; its crystal depths abound in speckled trout, and in other scarcely less esteemed members of the finny tribe. Altogether it presents to the amature idler as many advantages for the successful indulgence of piscatorial and primitive habits as can anywhere be found.

The soil is generally a strong clay loam, whose productive capacity is fully evinced in the annual crops, which are obtained by the limited and somewhat crude farming that has been practiced in the vicinity of the mines. The climate and soil are exceedingly favorable to the growth of pasturage, hay, oats, wheat, buckwheat, barley, potatoes, cabbage, turnips, and other roots.

The testimony of a number of farmers who were visited for the purpose of eliciting facts pertaining to this important industry, as applicable to this section of the country, was of the same uniformly encouraging character. A few of the results that were thus obtained may be here given to illustrate how, with market facilities, improved appliances, avenues of communication, a population devoted to farming might easily flourish.

Mr. L. Stannard, who is also a merchant at Rockland, has about 80 acres under cultivation, on which he raised 35 acres of oats the past year, which yielded 1,232 bushels; six acres of spring wheat, which yielded 30 bushels to the acre; one acre of potatoes, which yielded 200 bushels (has had 400 bushels to the acre); and he cut 46 tons of hay. He finds one acre of pasturage sufficient for a cow for the season, and he had single potatoes (Early Rose) which weighed three and one half pounds.

Mr. James E. Hoyet farms 40 acres; is also agent of the Rockland mine, and he had 100 bushels of sound corn on two acres, and exhibited at the county fair two squashes, grown upon the same vine, one of which weighed 100 pounds and the other 82 pounds. He also exhibited yellow pumpkins weighing 40 pounds and heads of cabbage that weighed 40 pounds.

Capt. Parnell, agent of the National mine at Rockland, tells me that he had three pailfulls of potatoes planted, which produced 52 bushels. He raised ruta baga turnips of an almost incredible size and of an excellent quality. Wild red and yellow plums are abundant, and some of the cultivated sorts flourish equally well.

Mr. Hoyet raised in his garden last season about seven bushels of this fruit, some excellent pears, and a quantity of choice apples. One long keeping sort, and, apparently, in all other particulars, valuable variety, is a seedling of his own raising.

Currants, raspberries, strawberries, etc., are readily produced in any degree of abundance, and it is found that apples can be raised with but little trouble and with much certainty. Duchess of Oldenburg, Red Astrachan, Fameuse, and Ben Davis trees grow and produce well. There are already, west of the Ontonagon river. and near the lake, orchards which yield more than the proprietors require for their own use, and thus have a surplus to sell.

The little farming which is done in this county is mainly in the vicinity of Ontonagon village and Rockland village and along the roads connecting them. It has grown up out of the necessities of the situation, and has seldom been taken up here from choice. No one ever went to this country with the intention of making farming a vocation. The early mining companies

were compelled to improve and cultivate a portion of their lands to aid in providing themselves with supplies. Men have gone to the Lake Superior country for the purpose of speculation,—to engage in mining or in trade,—to explore for minerals, but seldom to make a home, or with the expectation of remaining longer than suited some immediate purpose. It is difficult to induce people, now-a-days, except for a temporary object, to settle very far from the sound of the locomotive whistle, and a revival of the stagnant industries of Ontonagon county can scarcely be looked for, until railroad communication is secured, which shall extend from the harbor to the mines, and thence connect with some thoroughfare beyond. During the past summer a company was formed by some responsible Saginaw gentlemen to build a road from Ontonagon to the Wisconsin State line. For this purpose a grant of lands of six sections to the mile was made by Congress in 1856, and a line for the road was surveyed and the requisite amount of lands were withdrawn from the market and reserved to aid in its construction.

The line of this survey extends southeasterly from the mouth of the Ontonagon river, terminating in the State line, in the head waters of the Brulé river in the south line of town 42 N., R. 35 W. The grant of lands above referred to has been provisionally conferred by the State Board of Control upon the company, which has organized to build this road, and the matter only awaits Congressional action to designate the time within which it must be built, and a resolution of the Legislature confirming the action of the State Board, in order that operations shall actually begin. Great hopes are entertained by the people of the county that the undertaking may prove a speedy success. The road when built will naturally connect with the Northwestern branch, which runs along the Menominee iron range and must also be crossed by the easterly extension of the Northern Pacific, the construction of which is said to have already been begun from Duluth, to be built along the south shore of Lake Superior, crossing the Upper Peninsula from its southwestern boundary to the Straits of Mackinaw. These railroads, with the Detroit, Marquette & Mackinaw road, soon to be completed, will open up to settlement the best farming and timbered portions of the Upper Peninsula, and must necessarily result in a greatly improved condition of its business interests. The reserved railroad lands in Ontonagon county comprise very many valuable sections of pine, and already steps have been taken by some of the parties who propose to build the road towards preparing to manufacture lumber at Ontonagon on a large scale. The river with its numerous branches afford excellent facilities for floating and booming the logs, and Duluth and the great northwestern prairie country open a ready market. The Rich brothers, who for some years have been engaged in the manufacture of lumber at this point, are now building a mill of a capacity of about 15,000,000 feet annually to replace one which was unfortunately recently burned.

The line of the proposed railroad will afford admirable locations for blast furnaces for the manufacture of charcoal pig iron. The proximity to the iron range should reduce to a minimum the cost of the ore; the railroad and the harbor will afford the facilities for transportation and the abundance of hardwood along the line can be turned into charcoal, thus facilitating the settlement of the farming lands by furnishing to the settler a market for his cord wood, giving to him employment and profit while clearing his land and getting it ready for crops.

The present population of Ontonagon county is about 2,600, of which num-

ber 854 are in Ontonagon; 876 in Rockland, and the remainder principally in Greenland.

THE MINESOTA MINING COMPANY.

The manner of the discovery of the celebrated Minesota vein has already been related, and the effect of this discovery was to spread the fame of the region over the whole world. Accounts of the monster masses of pure native copper which the Minesota mine yielded were everywhere published, and the reality almost staggered belief. Masses of copper weighing thousands of pounds were purchased and taken to Europe to be exhibited as curiosities. The mine is located on section 15, T. 50, R. 39, and the company originally owned the north half of a three-mile square government lease (No. 98), consisting of 3,000 acres. The organization of the company was made in 1858 under a special charter granted by the Legislature of Michigan in that year.

The direction of the vein conforms to that of the rock formations, being N. 65° E., and is at No. 4 shaft 645 feet above the Ontonagon river, from which it is distant about 1½ miles, the river being to the west of the location. The vein is irregular, but generally of good width, from two feet to eight feet, and with well defined walls of trap. The dip of the shafts, which follow the vein, vary from 52° to 64° to the north. The rock formation dips at about 44°. The mine was at first opened on what was called the north lode, but four years later the workings of the National developed the value of a conglomerate and sandstone belt, lying but a short distance to the south, and work was immediately begun here, and as it follows the formation, dipping 44°, the two mines intersected in an irregular line at about the 40 level. This is shown in the cross section herewith presented. The gangue of the vein is quartz, calcite and epidote. Large crystals of quartz, weighing several pounds, with pyramidal terminations, were met with, incrusted with crystallizations of feldspar. Many very beautiful specimens of crystallized minerals, including copper, have been found.

The first shipment of copper was made in 1848, consisting of 6½ tons, which sold for a net price of $1,700, and assessments were made in amount $10,500 the same year. The company continued to work under the old charter until 1855, when a reorganization was made under the general mining laws of the State of Michigan, the capital stock being placed at $1,000,000 in 20,000 shares. Up to this time the entire under-ground workings aggregate upwards of 2½ miles; total length of levels 10,728 feet; total length of shafts 2,516 feet. The longest level was opened 1,663 feet, and the lowest, the 60-fathom level, 436 feet in length and 447 feet below the surface. At this time the yield of mineral per fathom was (1855) 890 pounds, which was an increase over previous year of 25 per cent, from which it was concluded as the mine had constantly increased in richness it would continue to do so. The mining population was (1855) 596, an increase of 74 in the year; 471 were men, 56 women, 69 children. The average number of miners during that year was 178, an increase of 43; entire force 463.

An addition to the estate of 470 acres was made, making the company's whole territory consist of 2,120 acres. Besides this there were 115 acres adjoining the mine, on section 16, the title to which was being contested in the courts with the National Company, a further notice of which will be made in connection with the history of that company's operations.

About 200 acres of land were under cultivation. Twenty-five acres of pota-

toes yielded 6,500 bushels=260 bushels to the acre; 15 acres of turnips, yielding 3,000 bushels. Thirty-two acres were sown to oats, producing 50 tons of straw and grain, and 70 acres were in meadow. These agricultural facts are given to show the productive capacity of the soil.

The mining plant was for some years greatly inferior to the wants of the mine, and the product was, no doubt much less in consequence than it might have been if enlarged facilities had been provided. Up to 1854 the hoisting was done in dribbles, and it was not until then that the shafts were fitted with skips and an engine and hoisting drums set up.

A small stamp mill with 12 heads of old Cornish stamps was erected, but there was a want of water to run except in seasons of rainfall.

The yield of the stamp rock was about four per cent.

The first dividend, of $30,000, was paid in 1852, the fifth year of working, and they were continued yearly thereafter.

The result of each years' work, from the commencement up to the time of the reorganization of the company, are as follows:

YEAR.	No. of men employed.	Expenditure.	Mineral Product.	Net Value of Copper.	Assessments paid.	Dividends Paid.
1848	20	$14,000 00	6½ tons.	$1,700 00	$10,500 00	----------
1849	60	28,000 00	52 "	14,000 00	16,500 00	----------
1850	90	58,000 00	103 "	29,000 00	36,000 00	----------
1851	175	88,000 00	307½ "	90,000 00	3,000 00	----------
1852	212	108,000 00	520 "	196,000 00	----------	$30,000 00
1853	280	168,000 00	520 "	210,000 00	----------	60,100 00
1854	392	218,000 00	763 "	290,000 00	----------	90,000 00
1855	471	281,000 00	1,434 "	550,000 00	----------	200,000 00

Notwithstanding the great financial revulsion of 1857 the company realized its usual profits and paid heavy dividends to its stockholders. The product for 1857 consisted of mass copper, 3,015,581 pounds; barrel copper, 819,900 pounds; stamp copper, 280,512 pounds; total product, 4,115,993 pounds; yielding 74.1 per cent ingot copper. This was an increase of 198 tons over the product of 1856, which product was 1,434 tons, of which 73 per cent was in masses. The total cost for mining, raising and preparing for shipment the whole product of the year, made up from the monthly returns from the mine, was $279,401.51, an increased cost per ton over previous years owing to the expense of cutting up the great masses which were found. The great riches of the mine at this period, 1857, is set forth in the following statement by Mr. Geo. D. Emmerson, mining engineer:

"It was against the established rule that a vein could lie between two kinds of rock so dissimilar as trap and conglomerate." * * "But they are finding immense masses of copper in the conglomerate under the vein. A few days ago this was showing in the most marked manner in several points. In the 20 fathom level, east of No. 5 shaft, in the south lode, the regular sheet of copper had been taken from the foot wall, and the yield at this point had been very great. The masses were from 12 to 18 inches thick. Strings of copper were cut off that seemed to branch into the conglomerate. These were followed and led immediately to very large masses, some of which were of the thickest copper ever before taken from the mine. One piece which was cut off presented a face of bright copper cut by the chisel three feet and nine inches

in thickness. It was so thick that it could not be handled in the mine without again dividing longitudinally, or splitting. Thus the mass showed two flat surfaces, at right angles with each other, of bright copper cut by the chisel. This point in the mine has been extremely productive. Some 200 tons of large masses have been taken out of the conglomerate under the lode, besides the enormous yield of the vein itself overlying it. In one place the copper extended into the conglomerate as far as 16 feet south of the foot wall.

"An occurrence of copper in all respects similar is found to the west of No. 5 under the adit level. Besides the masses in the regular vein, which was also extremely rich at this point, they had taken only 40 or 50 tons out of the conglomerate, the foot wall was perfect as in the other case, and strings leading into the conglomerate were quite small, and very slightly attached. But by trifling labor they uncovered a series of masses going up and down, with an eastward indication, for the height of 70 or 80 feet and going out of sight both above and below. It was at once apparent that they had something very valuable, but they had no conception of the immense thing which a few days' work disclosed. At one convenient point they broke away behind the copper so as to get in a sand blast of five or six kegs of powder. They stripped the mass further and again fired without result. Again they fired nine kegs of powder and the mass remained unmoved. Bucking the rock around for a considerable distance 18 kegs of powder were shot off without effect, and again 22 kegs, and the copper entirely undisturbed at any point. After further clearing, 25 kegs were shot off under the copper, and it was thought with some effect. But a final blast of 30 kegs, or 750 pounds, was securely tamped beneath the mass and fired. As soon as the smoke cleared away, a mass of copper 45 feet long and three to five feet in thickness, apparently very pure and which will probably weigh 300 tons had been shot out and was ready for cutting up. The blast had torn the immense body from its bed without exhibiting a sign of breaking or bending in any place, so great was its thickness and strength. It was torn off from other masses which still remain in the solid rock. About 100 feet to the east from this is another large mass which several parties are exposing, and from present appearances, it may exceed in size the last named one. These are near the point of the great counter lode from which 300 to 400 tons of copper have been taken; and the ground in the vicinity has unquestionably yielded the greatest amount of mineral ever taken from the earth in the same space. Its occurrence has been in three distinct forms: 1, In the counter lode; 2, in the regular vein; and 3, in the conglomerate rock under the vein.

"At No. 2 shaft they are sinking below the 60-fathom level, and are experiencing great difficulty in getting through the copper which they encounter. It was feared that they would be compelled to turn the shaft entirely out of the vein to enable them to sink. There are 1,000 tons of copper in sight—much of it ready for cutting."

A further extract, dated March 7, 1857, says: "There is now in the Minesota mine, between the adit and the 10-fathom level, a single detached mass of apparently pure metallic copper, which is some 45 feet in length, and in the thickest part as much as eight or nine feet in thickness. It contains probably more than 500 tons of pure metal, and is worth, as it lies, more than $150,000."

This is believed to have been the largest complete mass of native copper ever discovered. The exact weight was not ascertained, but enough of it was weighed to ascertain that the total would not fall short of 500 tons. Its greatest length was 46 feet, and its greatest breadth, 18½ feet; greatest thickness, 8½

feet. The main width was 12½ feet, and the main thickness four feet. It took 20 men 15 months to remove it from out the rock. Some of the cut faces measured 16 square feet. The cutting up afforded 27 tons of copper chips.

The product of the mine in 1858 was: Mass copper, 2,429,989 pounds; barrel, 903,871 pounds; stamp, 333,352 pounds; total, 3,667,212 pounds, yielding 70.1 per cent ingot. There was also obtained 70 pounds silver, which sold at $8.54 per pound. The total proper cost of production was $273,746.02.

In 1858 the company laid out 80 acres into a village plat, and commenced to sell lots. The company also purchased the south half of location 98, making the total estate 5,305 acres. The long pending suit with the National Mining Company was decided by the U. S. Supreme Court in favor of the latter. The entire population in 1858 was 910, of whom 85 were women. There were 36 births; 3 deaths by accident—7 deaths in all. The stoping cost $11.88 per fathom, and the yield in mineral was 945 pounds per fathom, average. The available surplus at the close of the year 1858 was $240,583.28.

The product for 1859 was: Mass copper, 2,040,454 pounds; barrel, 929,571 pounds; stamp, 282,092 pounds; total, 3,252,117 pounds, yielding 71 per cent = 2,305,204 pounds ingot, which sold at an average price of 22 cents per pound; dividend paid, $180,000. Two boiler explosions occurred, causing important damages to the pumping and other machinery. New boilers were procured from Detroit. Net earnings were $131,391.32; the average cost of sinking was $12.26 per foot; the average cost of drifting was $5.70 per foot; the average cost of stoping was $29.87 per fathom. The total length of underground openings was 31,893 feet; greatest depth, 698 feet, and greatest length, 2,077 feet. There were four hoisting engines and winding machinery, one pumping engine at No. 3 shaft, engine at stamping mill, with saw mill and feed mill. At two other shafts the hoisting was done by horse whims; another engine was required at Nos. 9 and 10. A warehouse was built; there were 400 acres of land under cultivation, producing 2,200 bushels of potatoes, 1,200 bushels of turnips, 170 tons of hay, and oats. The company had built a warehouse at Ontonagon, and a substantial dock at an early period of the work. A small steamer had also been put on the river to ply between the harbor and a point 6½ miles below the Minesota landing, between which latter points the flat-boats were propelled up stream by setting poles.

The profits for the year 1861 were $195,216, from which a dividend of $3 per share was paid. There was a falling off of 16 per cent in production from the figures of the year before, but the directors announced that they did not think it was due to any permanent decline in the productiveness of the mine, but only to temporary cause. The mine, however, was not showing heavy masses; there continued to be an abundance of smaller ones.

The product for the year 1861 was, mass copper, 2,402,226 pounds; barrel, 972,239 pounds; stamp, 223,132 pounds; total 3,597,597 pounds, yielding 72.94 per cent, and 195 pounds silver. The copper sold at an average price of 20.05 cents per pound. Expenditure on mining account, $401,281.39. Total receipts, $647,346.69. Investment in mining plant to date (1861), $267,561.81. Extent of mine opened—total length of shafts, 7,916 feet; deepest, 975 feet; shallowest, 200 feet. Cost for sinking per foot, $12.51. The total length of drifts, 34,987 feet; greatest length, 2,479 feet; lowest level, 120 fathoms; total length of underground openings, 42,863 feet. Cost per foot for drifting, $5.10. The cost per fathom for stoping was $8.16, and the average yield of mineral per fathom was 404 pounds, a great falling off, as will be observed,

from previous years. The average number of miners employed was 313; average monthly wages, $39.03. The entire force comprised 808 men.

The company found that by laying out the village of Rosendale they obviated the necessity of building dwellings, etc., by selling lots and furnishing lumber for sale; men built their own houses. Nos. 3, 5 and 10 shafts were furnished with skips and cars for hoisting, and substituting wire ropes instead of chains.

During several succeeding years the company suffered no diminution in its prosperity; the ratio of increase of yield was far greater than the increase of expenses, showing a degree of prosperity and a rate of progressive increase, which up to that period had been hardly paralleled in the history of mining enterprises.

The mine produced its maximum yield in 1860, and from that date began to fall off. But it had cost the original stockholders only $60,000. They were fortunate in having a rich mine from the start, which provided the means to procure the capital necessary for completing the improvement and for opening the mine. Upwards of $400,000 were expended before the company was enabled to pay dividends. It is seldom in the history of mining or of any other undertaking where the enterprise to be developed so nearly furnished its own capital to develop itself. The Minesota affords an instance of an extraordinary profit for a small investment, which it cannot be expected will be very often repeated, even in so remarkable a region as Lake Superior copper district. For every dollar paid the stockholders have received back nearly $30.

In 1866 the product had fallen to 285 tons. Work continued, however, in a moderate way until 1870 when the pumps were stopped in the old mine. But some previous effort had been made on the south bluff and was continued there but without developing anything of much apparent value. During the period of work in the old mine, the upper levels had not been worked out very closely, only the richest ground had been broken, and there was much left that would well pay for stoping. As the product in masses began to fall off there was more attention given to the stamp rock. A good deal of it had been neglected that contained a good percentage of copper, and by working it up the product of the mine was kept up pretty well for some years. In 1861 the stamp work was only six per cent of the total product, and the mass copper was 67 per cent. Five years later, in 1866, the stamp work was 43 per cent and the mass copper 36 per cent of the entire product. The old stamp mill, which was a crude affair as compared with those of later construction, was entirely unequal to accomplishing the work required of it. In 1865 the experiment was tried—an expensive one as it proved—of pulverizing the rock by use of rollers, but the attempt was an entire failure. The machinery was not properly designed nor constructed, and the work sufficiently demonstrated the fact to the satisfaction of the directors that no system of rollers, however devised, was adapted to the reduction of rock containing such masses of native copper.

In connection with this machinery an expensive launder was built, which also proved useless. This unavailing work was done at great cost, at a time when the company could not afford any useless outlay.

It seems to be difficult for a great mine like the Minesota, that for so many years had been working on a liberal scale, deriving an immense income, to suddenly circumscribe its affairs to conform to a greatly reduced magnitude; very much that is superfluous will remain that ought to be cut off. It was a good while before the managers realized the necessities of the situation. For some

years the expenses continued much greater than they should have been, and assessments began to be called for pretty heavily, and it was resolved to suspend work on the company account, but to continue only on tribute. The pumps were stopped in 1870 and the mine was thereafter allowed to fill with water.

From this date the mineral raised was by tribute working, and as there were plenty of miners living in the vicinity, no lack of tribute workers was felt. They would push into dangerous ground, where they could not be got to work when employed by the company. The number of miners engaged in the mine in 1870 was 43, and in August of that year 50½ tons were taken out, and in September 40 tons; in all for the year the product was 270½ tons, which sold for $93,336.48. The cost of production was $77,587.07, leaving net earnings of $15,747.14. The company held a previous surplus of $42,336.44.

The Minesota organized a number of mines, which gave it the name of the mother of mines. Among these were the Rockland, Flint-Steel, Lake Superior, West Minesota, Peninsula, etc.

The large scope of its operations, justified, perhaps, by its immense income, had a bad effect on minor organizations in this district. The Minesota became the pattern, and many of them followed her teachings to their ruin.

In 1874 the real estate was valued at $24,034.72, and other property per inventory, making total $167,418.35, and the cash on hand was $28,000; 93 tons, 373 lbs. ingot, were obtained.

During the work, the Minesota and National mines had been connected between the 60th and 70th levels, so that neither could work without pumping from the other.

The Minesota estate now comprises 5,000 acres; 500 or 600 acres were formerly under cultivation, and produced heavily in root crops, hay, and oats. This farming was an important item to the company, in the prosecution of its work.

The greater portion of the village of Rockland is the original plat of the Minesota Company, called Rosendale. The western part of Rockland was laid out by the National Company, and called Webster. The property has been well cared for by Resident Agent, Capt. Thomas D. James, who has been in the employ of the company 19 years; first as mining captain, and after the resignation of Capt. Wm. Harris, succeeded to the office of superintendent. Every thing about the mine remains intact, with the natural deterioration that time effects.

Captain James is now prosecuting explorations along the south bluff—Peninsula Bluff—which runs parallel with the old mine. The work formerly done here consists of two shafts 275 feet apart, and sunk to a depth of 300 feet from the surface, and an adit driven through the bluff from south to north.

The diamond drill work was begun in July last, and has been prosecuted along the bluff about 1,300 feet, and to a depth of 350 feet. The purpose is to continue this work of exploration along the lode to the limits of the property, and ultimately to commence work at what may be deemed the most feasible point. The drill cores are sampled and washed to determine percentage of copper, and other notable facts are recognized as the work progresses.

The product for 1880 is 50,054 pounds crude copper, yielding 72 to 75 per cent of ingots. This product was obtained in the old mine above the fourth level, below which the mine is filled with water. The number of men kept employed is about 35.

A longitudinal section of this mine is herewith given, and shows the depth and extent of the workings. The mine has really never been proved to a great depth. At the time work ceased, or shortly before, the agent reported to the directors: "The chances for copper in the bottom might be greater than in the upper levels, yet this could only be proved by sinking shafts and extending drifts, which cannot be done without considerable expense. I wish it might be done to further prove the mine, as there is a chance of striking rich copper ground."

This matter of proving the mine at greater depth never has been done. The theory assumed in the productive days was that the mine was inexhaustible, that it must grow richer as the depth increased. But subsequently the opposite theory was embraced, that the vein was necessarily shallow and was therefore exhausted. Theories and hypotheses are of little value in the Lake Superior copper region. They know what they have when they discover it and prove its value, but it is nearly useless to predict anything beyond what can be seen.

The diamond drill is the best instrument to use to determine the value of of predictions, and it would be interesting and might prove important to those more immediately interested, to employ the drill in the bottom of the old Minesota mine. Until it is thus tried it is useless to conjecture one way or the other regarding the existence of copper in paying quantity at still greater depths. The following shows the dividends paid by the company:

Years.	Dividend paid.	Years.	Dividend paid.
1854	$90,000	1860	$120,000
1855	40,000	1861	100,000
1856	100,000	1862	60,000
1856	100,000	1862	100,000
1857	150,000	1863	60,000
1857	150,000	1863	100,000
1858	120,000	1864	60,000
1858	180,000	1872	50,000
1859	100,000	1876	10,000
1859	80,000		

Officers of the company are: H. F. Emory, President; Geo. D. Farr, Secretary and Treasurer; office, New York.

NATIONAL MINING COMPANY.

The most important of the mines of Ontonagon county, after the Minesota, is the National, which adjoins it on the east—T. 50, R. 39 W., Sec. 16.

This successful enterprise was inaugurated under a special charter granted by the State of Michigan, April 1, 1848, with Geo. W. Page, James Anderson, Morgan L. Drake, James A. Weeks, and Henry B. Marsh as corporators, with office in Pittsburg, Pa. But its mining work was then in the location above described, until 1852, when the company acquired the title to 1,540 acres of land in township No. 50, range 39. In this purchase was included 595 acres in section 16, and it was over the title of a portion of this land—115 acres adjoining the Minesota—that a long and costly litigation arose, that went thrice to the U. S. Supreme Court, but was decided fully in favor of the National.

The National Mining Company derived its title to its lands on section 16 by deed from Alfred Williams, who bought them from the State of Michigan, who sold them under virtue of the act admitting her into the Union, wherein it is provided that section 16 of each township shall be given to the State for school purposes, etc. The matter came before the Legislature, which passed a confirmatory act, and recognizing the patent of Williams from the State as fully valid, etc.

Subsequent to the sale of the land by the State the Minesota Company obtained a conditional patent from the United States to a portion of the same land, being a strip 80 rods wide, two 80-acre lots on the east side of section 16. The patent derived from the general government expressly reserved all the rights due the State of Michigan in these lands. But another basis to the Minesota title was the fact that these lands were included in the "homestead lease." Permit No. 98 was issued by the War Department in 1845. The Minesota patent from the United States bore date September 16, 1852, and included the lands embraced in the homestead lease; but, as before stated, reserved the rights due to the State of Michigan to lands on section 16. These lands adjoined the richest part of the Minesota mine, and were crossed and contained nearly 90 rods in extent of the Minesota lode, so that it was too valuable a prize to be given up without a struggle. Every legal effort was made by both parties to the suit, and it was fully tried upon every issue that could be made. It was tried in the Ontonagon circuit, in the State Supreme Court, before the Legislature, in the U. S. District Court at Detroit, in the U. S. Supreme Court at Washington; then back again to the District Court, and a second time in the U. S. Supreme Court, where a final decision was rendered in 1857, after five years' litigation, confirming the title of the National Company to the land.

The property was purchased by the owners of the Cliff—Messrs. Hussey, Howe, Cooper, etc., and in July, 1852, a party in charge of A. Rudolph, began exploring work upon the conglomerate vein, the vein, which lies between the trap and the conglomerate before described in the history of the Minesota. The outcrop was plainly marked by ancient excavations, and proceeding to open one of the largest of these, which proved to be 50 feet in depth, having become filled up with clay, sand, and vegetable matter, there was found in it the remains of timbers which once formed a scaffolding across the shaft, and down the side was found a broad sheet of copper, which covered nearly one side. From the bottom of this opening the first shaft was sunk; and very soon, in the progress of the work, were intercepted masses of copper. No. 2 shaft was begun immediately, at a distance of 240 feet to the west, in the vein. At suitable depths these two were connected by levels, and winzes sunk. The character of the vein was found to be entirely similar to its extension on the Minesota, with the exception of proving less productive in masses. During the next year, 1853, copper was shipped from the mine, amounting to 34,908 pounds in masses, and 46,406 pounds of barrel-work, yielding 72 per cent refined copper.

From the conglomerate a cross cut was made to the north to intersect the Minesota vein. In 1854 Capt. John Chynoweth took charge of the mining department and remained in the employ of the company, subsequently as agent, for upwards of 25 years.

The total expenditures of the company up to 1854 amounted to $61,308.27, and the receipts from sales of copper, $13,618.39; from assessments, $39,658;

expenditures to July, 1856, were $154,351.15; assessments, $109,860, and sales of copper, $49,419.15; force employed in 1856, 80 men, of whom 46 were miners. The machinery for a stamp mill was procured, but in view of the small amount of stamp rock obtained it was deemed advisable to postpone the erection of the mill until a quantity of stamp rock had accumulated.

The copper raised from the commencement to June 30, 1864, was 90 1307-2000 tons; to June 30, 1855, was 55 1042-2000 tons.

The first agent was Wm. Petherick, afterward of the Copper Falls mine, who was succeeded in 1855 by Mr. Wm. Webb, who had been agent of the Cliff. The last assessment was made in April, 1856, making, as before given, $109,860. From that time forward the mine furnished sufficient copper to pay current expenses. The product of the mine for 1856 was 187,141 pounds of mineral, yielding 76 per cent refined copper.

The product for 1857 was 165 942-2000 tons of ingot copper = 82 per cent of mineral produced.

A hoisting and pumping engine, 17-inch cylinder, 5-foot stake, to operate Nos. 1 and 2 shafts, was erected in 1857. The mine was found to be the richest to the east adjoining the "disputed track," and the mine was more extensively worked in that direction, ready to push into this coveted territory as soon as the title should be confirmed in their favor, as the company confidently expected it would be. As soon as the company entered upon the possession of this land its mining operations were thenceforward transferred to it, and a new mine was begun. In the next 12 months five new shafts were sunk at a distance apart of 275 feet, and connected by levels, which made a total amount of drifting of 1,933 feet, and in doing this work copper enough was obtained in the ground that was opened to pay the entire cost of the work from first to last; the first instance of the kind, so claimed, to be found on Lake Superior. The average mining force during this year, that was employed, was 72 men. The shipments to the close of navigation, 1858, were 231 masses, 171,582 pounds; 203 barrels, 139,317 pounds; which, smelted, yielded 264,621 pounds of ingot, being 82.1 per cent.

The company's legal title to the new territory was assured; the mine was realizing all that had been anticipated, and the company entered upon a career of remarkable success. During this year the National, as had been done by the Minesota, laid out a village plat and sold lots, upon which 40 houses, 4 stores, shops, etc., were built the first season. The town was called Webster. The lots were sold at $300 each. The company also had 50 acres of land under cultivation. A dock at the landing on the Ontonagon river was built, and a flat-boat constructed to convey products to and from the harbor. This boating in the river, however, soon gave way to the more expeditious and safe method of conveying by wagons over the plank road that was finally built, mainly by the Minesota and National mines, to Ontonagon village. This road was begun in 1857.

The greater portion of the product of the mine was in masses, but the discrepancy was not as great in this respect as it was at the Minesota mine. Up to the close of 1858 the total receipts from sales of copper were $219,174.01.

Product, 1859: Mass copper (305), 459,744 pounds; barrel copper (250), 186,622 pounds; total, 646,366 pounds, which yielded 75.5 per cent = 488,176 pounds refined copper, which sold for net cash, $105,768.50. The two mines were completely connected, making one mine.

In 1859 the local authorities at the mine being somewhat troubled with the

LONGITUDINAL SECTION OF THE NATIONAL MINE, JAN., 1881.

Scale, 300 ft. to one inch.

accumulations of stamp rock, conceived the plan of improvising a stamp mill. Accordingly, the old machinery that was got when the mine first started was brought into requisition, and the deficiencies supplied by borrowing or purchasing of neighboring mines, and eight heads were set to work, with washing floors, etc., attached to the saw mill engine. A dam was built across the little rivulet that winds between the bluffs, and 8 or 10 tons per month were thus added to the product.

The product for 1860 embraced stamp work for the first time: 628 masses, 923,418 pounds; 521 barrels, 437,606 pounds; 94 barrels stamp, 94,384 pounds; total, 1,455,418 pounds, yielding in refined copper 73.96 per cent = 1,078,608 pounds, which sold for net cash, $221,417.68 = 20.5 cents. The entire receipts of the company, from commencement of operations to date, were $748,061.17. This year the company declared its first dividend—$4 per share paid in January and in July, 1861.

The product for 1861 was 762 masses, 1,109,796 pounds; 613 barrels, 499,962 pounds; 215 barrels stamp, 274,559 pounds; total, 1,884,317 pounds. This yielded 73 286-2000 per cent = 1,383,761 pounds refined copper, which sold at an average net price of 20.29 cents = $280,763.57. The cost of production, by which is meant all mining expenses, transportation of all materials and products, fuel, salaries, timber, etc., etc., $149.36 per ton of mineral. Two dividends of $2 each were declared.

But for the first time since opening the new mine there began to be a falling off in the product. The decline was very noticeable in the last two months of the year. Up to this time there had been a steady increase of product; every increased effort had been rewarded by an increased product, but they were at length overtaken by one of those lean streaks that have occurred in nearly all mines on the lake, but which are generally overcome. The fifth level was opened on the whole line of shafts, and great expectations were entertained; but they were unfortunately not fulfilled; only a small amount of mass copper, which at that time was deemed to be the essential portion, was found. Nos. 1, 3 and 4 shafts were furnished with iron track railway, and with iron skip wagons, drawn up and down with wire rope. These arrangements, since so common, were deemed then a great improvement. Much of the hoisting had been done with buckets holding 1,000 pounds, drawn up with ropes or chains, and there were frequent mishaps and damages. The plank road, 13 miles, had been completed. The distance by the river was 22 miles to Ontonagon. The cost for hauling to Ontonagon was $1.50 to $2 per ton. One hundred and twenty-seven acres of land were bought, and the number under cultivation was 300, producing in 1861 75 tons of hay, 25 tons of oats in straw, 2,000 bushels of potatoes, and 1,000 bushels of turnips. The number of stamps was increased to 24 heads, and the number of men employed was 129, of whom 61 were miners, who received an average price of $40 per month. The average yield of mineral per fathom stoped was 520 pounds.

The product for 1862: Mass copper (474), 481,638 pounds; barrel copper (423), 370,218 pounds; stamp copper (28½), 340,244 pounds; total, 1,192,100 pounds, a falling off from the previous year's product of 364 tons. The yield per cent was 72.08 refined copper = 865,752 pounds ingot, which sold for 24.17 cents per pound net, or $209,230.56. The cost of the mineral for the year was 14.65 cents per pound, and cost per pound for ingot, 20.33 cents.

The suit, which had been decided in the Supreme Court of the United States in 1857, was started by the Minesota Company, in the form of an ejectment, in the State circuit, and decided in favor of the National, was appealed to the

State Supreme Court, and there the decision of the local circuit was affirmed. But it again went to the Supreme Court of the United States, and was again decided in 1866, making three times it went to this court.

The yield per fathom stoped in 1862 was 274.5 pounds; total dividends declared, $160,000.

The company was crippled in stamping facilities, arising from the crudity of the stamp and the insufficiency of water. Product of the mines for 1863 was 230 masses, 244,801 pounds; 298 barrels, 253,845 pounds; 282 stamp barrels, 294,313 pounds; total, 792,959 pounds; this yielded 70.90 per cent = 516,179 pounds ingot copper, which sold for 32.97 cents per pound = $185,027.94. The net profit for the year was $38,134.86; the cost of the mineral was 18.56 cents per pound; the cost of the refined copper was 26.17 cents per pound, showing a profit of 6.80 per pound.

The directors thought that the mine had now reached its minimum production for many years to come; henceforth they declared better results might be looked for. This expectation was based upon the developments made in what was called the middle vein. It was first intercepted by a cross-cut from the main lode, and was nearly equi-distant from the north lode and the south conglomerate, and ran angling so as to intercept them both. It was worked by drifts from the main lode, and carried mass copper in considerable quantity.

The conglomerate is made up here by a mixture of a great variety of minerals, cemented together by a silicious matrix. The vein is a fissure in it. The conglomerate carries but little copper. The vein, while in it is not of it, so that the company was now working two lodes. The north lode had only been slightly explored, but it was not thought to carry much mass copper, but to be good in stamp rock, and not having stamping machinery, the company had not worked it. No. 8 shaft was fitted with engine and hoisting machinery, and pumping machinery, etc. This shaft was near the west end of the mine, but was not worked for want of men, which were scarce at this time in the mining region.

The product for 1864 was 385 masses, 433,458 pounds; 318 barrels, 260,336 pounds; 299 barrels stamp, 314,883 pounds; total, 1,008,677 pounds, which yielded 65.69 per cent = 688,516 pounds ingot copper, realizing 46.19 cents per pound = $318,075.06. The cost per pound was 20 cents = 30.645 cents per pound refined copper; the average force employed was 108 miners, 122 laborers; the aggregate sales for copper and silver, $1,431,831.40; the average wages paid to miners were $57.22 per month; the average wages paid to surface men were $50.69 per month. A severe storm in July carried away the dam and wash house, etc., and did other serious damage. The dividend for the year was $80,000.

In 1865 the product was 383 masses, 516,424 pounds; 364 barrels, 294,342 252 barrels stamp, 256,584 pounds; total, 1,067,355 pounds, yielding 66.71 = 690,271 pounds refined copper, which sold for 29.71 cents per pound = $205,076.74. The expenses of every description were $246,453.25; the average number of miners was 122; average wages, $51.61; the average number of surface men was 137; average wages was $46.75; aggregate receipts to date were $1,784,655.74. Smelting works were built at Ontonagon by M. DePontalba, and the National product was smelted there, proving satisfactory.

The middle vein, branching off from the conglomerate at an acute angle, starting from a point between Nos. 1 and 2 shafts, runs westerly, and dips at a greater angle than the conglomerate, and intersected in the tenth level. It was found to continue to yield well.

The product for 1866 was 356 masses, 446,396 pounds; 233 barrels, 188,062 pounds; 254 barrels stamp, 276,834 pounds; total, 911,292 pounds, yielding 71.77 per cent = 647,371 pounds ingot; this sold for 29.20 cents per pound = $189,008.76. There was also obtained 679 ounces of silver, which sold for $916.71. The total expenses of all kinds were $177,659.37. The average number of miners was 122; average wages per month, $42.20. Number of surface hands, etc., 128; wages, $39.95. Total receipts, $2,015,685.70. Total number of acres, 1,899.25. Surplus, $30,985.16.

Mr. Wm. Webb, who had been agent until this time, retired, and Capt. John Chynoweth assumed the duties. The product for the eastern part of the mine was found to decline; the stamp rock proved too scarce and poor; the directors decided to reduce the force and curtail expenses. The farm products for the year were 100 tons of hay, 15 tons of oats and straw, 1,200 bushels of potatoes, 2,500 bushels of turnips. Number of tons of rock stamped per month, 1,300; the total cost for stamping and washing was $1,200; the total cost of producing one ton of copper was $105.64; the profit on a ton of rock was $1.67, exclusive of mining cost.

The product for 1867 was 238 masses, 257,175 pounds; 160 barrels, 126,454 pounds; 272 barrels stamp, 264,635 pounds; total, 648,264 pounds, yielding 71.965 per cent = 475,633 pounds refined copper, which sold for 23.80 cents per pound = $113,486.46; silver sold = $495.66. The total expenses were $131,121.92; the total receipts to date, $2,144,267.48; the average number of miners employed was 74; whole number of employés, 156. The average cost of treating the rock in the stamp mill was 99 cents per ton of rock, which yielded 1.03 per cent of copper. About one-half of the rock stamped was taken from the old burrows, which accounts, in a measure, for the ton percentage. The Ontonagon smelting works suspended work.

In 1868 the product was 197 masses, 400,783 pounds; 90 barrels, 74,507 pounds; 174 barrels stamp, 162,258 pounds; total, 637,548 pounds, yielding 71.48 per cent = 443,048 pounds refined copper, which sold for 23.81 cents per pound = $101,083.51, and silver sold for $178.74. Total expenses, $88,594; total force of men, 112, of whom 50 were miners; added surplus, $10,123.57; aggregate receipts, $2,244,340; cost of treating the rock in the stamp mill, 93 cents per ton. The conglomerate rock, upon which belt work had been begun, was found to be hard to treat, and yielded about one per cent of copper; 75 tons of the product were obtained from the middle vein.

In 1869 the product was: Masses, (121), 229,391 pounds; barrels, (60), 46,384 pounds; barrels stamp, (139), 135,557 pounds; total, 411,332 pounds, yielding 69.34 per cent. which sold for 21.89 cents per pound; silver amounted to $336.60. Total expenses for the year were $60,787.45; number of miners employed, 36; total force, 86; aggregate receipts, $2,300,356.16.

The work on the north or conglomerate failed to realize as fully as was expected, and was stopped after a cross-cut was made to No. 1 level in the main mine.

So great had been the falling off in the product, and so much effort was necessary to keep the expenses within the income that the stockholders became discouraged and alarmed lest there should be assessments. The mine had been run for several years without profit, and at a meeting of the stockholders October, 1870, it was resolved to shut down.

Discontinuing work for a length of time in a mine that had been conducted on so large a scale as the National, is a serious matter, as it occasions great destruction of machinery and of property of all kinds. Under the advice and

direction of Capt. Chynoweth, work was resumed in the mine in 1871, on tribute. Up to 1874 there was produced 461.5 tons, which sold for $218,456.98. The total receipts to 1874 for copper were $2,295,231.50; the total receipts to 1874 for silver were $6,315.78. And there had been paid in dividends $319,255; and the total assessments had been $110,250.

A limited amount of work was done by the company, through the advice of the agent, in 1874, in the west end of the mine, in what is called the creek shaft, but was abandoned soon after, and only tribute work has been done in the mine until 1880. Tribute work proved profitable; the tributors, by tearing up the levels and taking out the pillars, got out annually considerable amounts of copper. One party struck a 40-ton mass, which afforded to them a profit of several thousand dollars.

In 1878 the control of the affairs of the company passed into the hands of Boston parties, and the office was removed from Pittsburg to Boston. Capt. Chynoweth remained in charge until 1878, when he resigned and moved to the Mass mine. He had been in charge of the National mine for 26 years, and the owners had frequently expressed their great consideration for his efficient services, and their unbounded confidence in his integrity.

When it was decided by the present owners of the National to unwater the mine, and to resume work, the services of Capt. Ed. Parnell were secured for this work. Captain Parnell had for years been an employé at the National, and previous to 1870 had been mining captain, since when he had been at the Phœnix and at the Franklin mines, so that his experience as a practical miner, and his familiarity with the National mine fitted him for this important task, and those who know him, and are familiar with the work to be done, regard his selection as a very judicious one.

Capt. Parnell took charge of matters at the mine in May, 1880. Ten years of only tribute work, with no expenditures for repairs, had naturally brought everything to a dilapidated condition. The ground had been worked away from under the shaft houses and machinery; in instances, causing the surface to fall in. The mining plant and buildings are much out of repair. Captain Parnell has cleared out No. 2 shaft, from the surface down to the water, and lined it up, and built over it a large, substantial shaft house, in which he has placed the large pumping engine on a strong foundation of masonry. This engine has a 20-inch cylinder and 4-foot stroke, and is deemed of sufficient capacity to work the pumps. The bed for the large hoisting engine has been made, laid in masonry, and thoroughly done, and the engine will be got in place during the winter. In the meantime the hoisting will be done with a small engine that is already at work, and placed at a short distance south of the pumping engine, the hoisting ropes being carried up from the small winding drum to the top of the shaft house, and thence down the shaft. A new stone boiler house has been built west of the shaft, and three large locomotive boilers are in place, ready for work. The water pipe—14-inch—and pump rod are down to the water in the mine—235 feet, and the working of the pump will soon begin (December, 1880). Captain Parnell estimates that a year will be consumed in this work of unwatering the mine and clearing it of rubbish left by the tributers.

Above the 50-fathom level the mine is connected with the Minesota and the Rockland mines, so that above that point the water must be pumped from all three; also a greater amount of water finds its way into the mine than formerly, owing to sinking in of the long adit, and about the shafts, etc., giving more surface drainage into the mine. Were it not that the long adit had

become completely obstructed it could be used to great advantage in clearing the mine of water; but as it is, the water must be brought to the surface.

When freed of water and debris, the purpose is to sink and explore the mine to greater depth. It is hoped that this work may develop riches that shall cause the future history of the National to rival the best period of its past.

It is an undertaking fraught with much interest; for if it proves favorable, doubtless the Minesota will also resume operating—thus restore to the now comparatively idle village of Rockland, a measure of its former activity.

A favorable result of these explorations will also tend to establish the fact, which the history of the Quincy has determined, regarding stamp lodes: "That in a mass vein, although barrenness may occur, it is not conclusive evidence of utter exhaustion."

YEAR.	No. of Pounds of Mineral.	No. of Pounds of Refined Copper.	Per Cent.	Price.	Cash Received for it.
1854 and previously	78,834	55,689			$ 13,618 39
1855	149,226	105,217			24,246 91
1856	223,688	176,483½	79	$ .22⅛	39,156 86
1857	403,795	330,942	82		73,363 86
1858	310,899	264,621	85.5		57,162 70
1859	646,366	488,176	75.5		105,768 50
1860	1,455,418	1,078,608	73.96	20.5	221,417 68
1861	1,884,317	1,383,761	73.286	20.29	280,763 57
1862	1,192,100	865,752	72.08	24.17	209,230 56
1863	791,416	516,179	70.90	32.97	185,027 04
1864	1,008,677	688,516	65.69	46.19	318,075 06
1865	1,067,355	690,271	66.71	29.71	205,076 74
1866	902,040	647,371	71.77	29.20	189,008 79
1867	660,924	475,633	71.96	23.86	113,486 46
1868	619,820	443,048	71.48	22.81	101,083 51
1869	411,332	256,947	69.34	21.84	56,257 21
1870	320,966				61,249 00
1871	555,440	386,776			84,165 24
1872	484,998	224,568			105,201 02
1873	243,963	155,521			39,431 98
1874	127,968	55,871			11,132 42
1875	146,721				
1876	228,870				
1877	103,329				
1878	35,496				
1879	22,560				
1880					

The officers are D. L. Demmon, Secretary and Treasurer, No. 19 Congress street, Boston; Capt. Ed. Parnell, Agent, Rockland, Mich.

ROCKLAND MINING COMPANY.

The Rockland Mining Company was formed under the general mining laws of the State, September 27th, 1853; capital stock $500,000 in 20,000 shares. The location was set off from the Minesota estate, and was conveyed to the Rockland Company at an estimated consideration of $100,000, paid in Rockland stock at $5 per share, fully paid up. The track conveyed adjoins the Minesota on the east, and consists of 480 acres, being the S. E. ¼ Sec. 10, the S. W. ¼ Sec. 14, and N. E. ¼ Sec. 15, T. 50, R. 39, and is crossed by the Minesota veins. The bluff in which the Rockland mine is situated rises 40 or 50 feet

above the surface of the Minesota mine, and affords on the north side towards the valley, through which courses a small stream, an excellent opportunity for drainage by an adit.

An adit was begun in 1853 from the north, and driven to the south, and at a distance of 390 feet intersected the north vein at a distance of 170 feet below the surface; 100 feet further south is the south lode. Then shafts were sunk in the vein to the adit level, and connected with drifts. Assessments were made to the amount of $3 per share during 1854; and during that year—the first year of work—46,000 pounds of mineral were obtained, which smelted, yielded 75 per cent = 34,554 pounds ingot copper, and sold for $8,824.91. The improvements, buildings, etc., $10,000.

The total product to February 1, 1856, was 160 tons of mineral, two-thirds of which was in the form of masses. One mass weighing 6,075 pounds, taken from an ancient pit, and bearing the marks of the rude mining tools of a former period and an unknown race, was sold and sent to England as an object of great curiosity. The balance of the year's product was smelted, yielding 70 per cent = 139,801 pounds, which sold for, including the mass, $40,000 = 27.7 cents per pound. At this time the total length of the four shafts was 520 feet, the deepest one being 200 feet, and the shallowest 80 feet; and the total length of the three levels, adit, and cross-cut was 1,837 feet.

The mining affairs were conducted by Mr. James B. Townsend, agent of the Minesota.

In 1855 and 1856 a stamp mill was erected with washing floors, etc., and 8 of the 12 heads were put in operation. The rock was drawn from the mine to the stamp mill in cars run on a railroad track.

In 1856 a cross-cut was run to the south lode, and drifts extended east and west on the vein, which overlies the conglomerate. The vein was found to be about two feet thick, and yielded barrel-work. The rock, etc., from this vein had to pass out of the adit 550 feet, as no shaft had been sunk. It was found that there was not enough water to do the stamping and washing, notwithstanding such an abundance had been predicted.

Great expectations were entertained respecting the success of this company, and the directors expressed their predictions with a good deal of confidence.

The product for 1856 was: Masses, 249,774 pounds; barrels, 140,497 pounds; stamping, 99,667 pounds; total, 489,938 pounds; amount smelted, 384,891 pounds, yielding 73.48 per cent = 282,067 pounds ingot, which sold at an average of 26¾ cents per pound = $68,524.36. The expenditures for the year were $87,194.88. The company deemed itself to be out of debt, and ready to coin dividends. A force of 153 men was employed, of whom 73 were miners. An additional one-fourth section of land was purchased, and the right of way of the Ontonagon and State Line railroad, through the company's location was granted.

The total expenditures for the year 1857 were $129,652.77. The mineral shipped for the year was 780,554 pounds, yielding 73 per cent = 568,264 pounds ingot copper, which sold for 23.63 cents per pound = $132,740.74; balance on hand, $10,895.54. Total depth of the 7 shafts, 1,194 feet—deepest, 293 feet; total length of levels, 4,871 feet; average yield per fathom, 654 pounds of mineral; number of men employed, 167, of whom 92 were miners. The stamp mill was leased to the Minesota a portion of each year, at $500 per month.

The dividend which the directors promised the stockholders in 1857 was not forthcoming. Hoisting and pumping engines and machinery were put up on

the north vein, and work resumed in the stamp mill, expecting that the north vein would supply the stamp rock, which it failed to do. The mineral being insufficient to meet the expenses, assessments amounting to $4 per share were made.

The total product for the year 1858 was 503,750 pounds, yielding 74 per cent =372,647 pounds ingot copper, which sold for 22.58 cents per pound = $81,762.60. The total expenditures for the year were $128,761.43; $3 per share of the amount assessed was called in, making $60,000.

The directors announce that they believe the critical period has passed, and henceforth the mine will be a successful and profitable enterprise. But they were doomed to disappointment; nevertheless the business of 1859 was an improvement on its predecessor.

The shipments for the year were 693,747 pounds, yielding 74.3 per cent = 515,788 pounds, which sold for 22.17 cents per pound = $114,393.64. The total expenditures were $122,570.86; no assessments were called in.

The Rockland Company struggled faithfully to make the mine a success, but could not make it self-sustaining—much less pay dividends. The stockholders hoped to have a mine that would rival the Minesota, and pushed matters with considerable vigor, employing a large force of men, working in the same veins as the Minesota, but they did not yield as well. The outlay and expenditures were doubtless greater than the production justified. It started off well, but after a few years the product began to run down, and so continued.

In 1865 new openings were made in the southeast corner of the property, in the bluff, where two parallel veins about 30 feet apart are exposed. Here two shafts were sunk in the southerly vein; this vein was selected from the fact of its greater length on the company's property; an adit was driven for drainage, etc.; seven acres of land were purchased from the Minesota Company to give room for this adit, to get rid of the waste rock, etc.

The product at this time, 1865, was 177,301 pounds, yielding 66.47 per cent = 116,077 pounds ingot, which sold for 31.09 cents per pound. The total expenditures were $65,347.39, leaving a deficiency on the year's business of $22,254.82.

Work was continued in these new openings until 1870, when the company shut down, the stockholders having contributed nearly the entire amount of the capital stock, and received no return.

The property passed into the hands of Boston parties—the same who own the National. The company had 400 acres under cultivation; own 760 acres at the location. The stamp mill has fallen in, and much of the mining plant, buildings, etc., are in a somewhat dilapidated condition. The main shaft house, containing engine and hoisting apparatus, was burned in 1878, and greatly damaged the machinery, which had been put in but a short time before the old company shut down.

The mine has been worked by tributers more or less for the last ten years, and some large masses have been found, one of nearly 40 tons weight. The product for 1880 was 47,000 pounds rough copper, yielding 72 per cent of refined metal.

D. L. Demmon, Secretary and Treasurer; office, Boston, Mass. James E. Hoyt, Agent, Rockland, Mich.

LAKE SUPERIOR COPPER COMPANY.

The Lake Superior Copper Company was organized by the stockholders of the Minesota to work a portion of their estate. The location comprises 895 acres in Secs. 13 and 14, T. 50, R. 39. The company was formed in 1859, and the mining work was done on the E. ½ Sec. 14. An adit was driven in from the north side of the bluff about 150 feet, to intersect the Minesota vein, and two shafts were sunk—one on the north vein, and one on the south vein—to the adit level, 75 feet. A second adit was subsequently driven in from the east side of the bluff to where a surface pit showed promising indications of copper. A shaft was sunk, and considerable copper was obtained from this point. This latter work, near the Flint Steel line, was done in 1873–74, since which time no mining work has been done by the company; but some tribute copper has from time to time been taken out. The total product of the mine since 1868 is 17 tons; product of 1874, 7,270 pounds; 1875, 7,029 pounds; 1877, 2,789 pounds of mineral. The total assessments amount to $40,000.

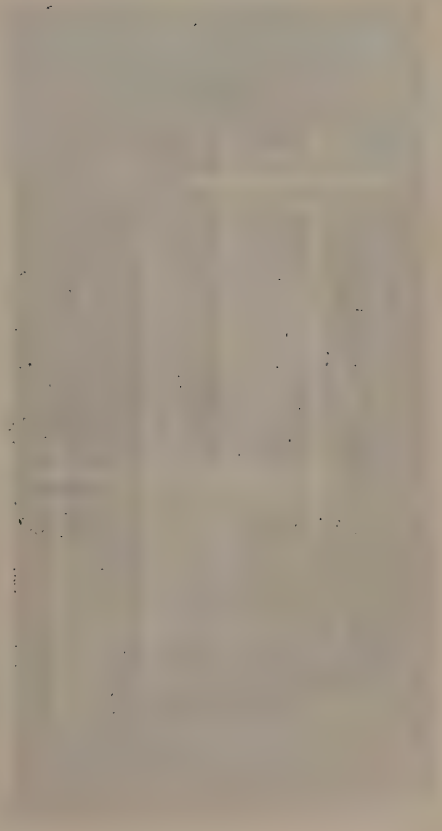
The company never had any machinery at the mine, except horse whims. A few buildings constitute all that there is now to be seen.

D. L. Demmon, Secretary and Treasurer; office, Boston. S. B. Harris, Agent, Greenland, Mich.

FLINT STEEL MINING COMPANY.

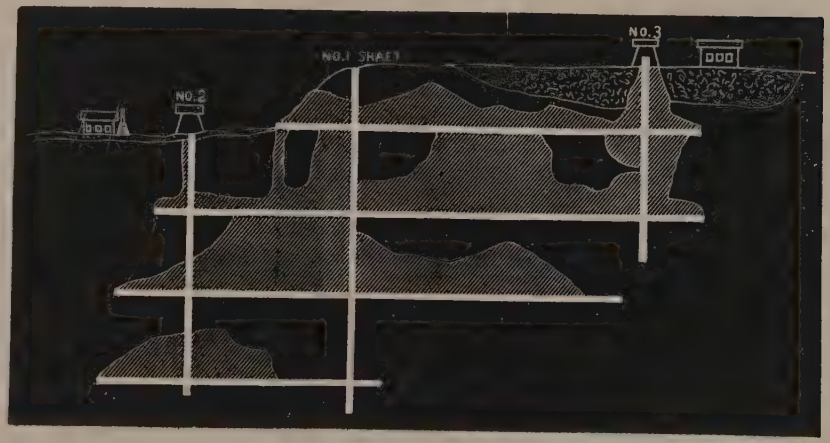
The Flint Steel Mining Company was an early organization, owning the S. W. ¼ and W. ½ of the S. E. ¼ of Sec. 12, also the S. E. ¼ Sec. 11, T. 50, R. 39. Work commenced by opening some old Indian pits, in which several short shafts were lowered and some drifting done. The land was set off by the Minesota Company, and the company organized in 1855, but had been worked in 1850; the vein did not prove productive. The location comprises the eastern extremity of the bluff, where it is cut in two by the Flint Steel river, which here makes a broad gap through the range. The river lies several hundred feet below the tops of the spurs, which confront each other upon opposite sides, the western bluff comprising the Caledonia mine, and the eastern the Flint Steel. West of this gap the hills of the Minesota range lie with great regularity and symmetry; their summits are notched in only one or two places, and these superficial indications of regularity are sustained in the underground works of the important mines located in that direction. But to the east of this gap the mines show all the contortions and twistings corresponding with the broken and irregular superficial contour. These two mining locations, occupying the two sides of the Flint Steel gap, are now controlled by one company. The Caledonia was formerly known as the Nebraska; changed to the Caledonia in 1863.

These companies paid in assessments—the Flint Steel $204,000, and the Caledonia $140,000, and were consolidated in 1871 as the Flint Steel Copper Company. Prior to their consolidation each had done considerable mining work, and found some copper in isolated masses, but the irregularity of the veins renders it very perplexing and uncertain work. Each of the companies had built a small stamp mill, but the Caledonia mill was burned in 1870. This mine is opened with two adits from the west side of the bluff, extending about one-half way through; the upper one being 625 feet in length, and the lower one 603 feet long; these were connected by two winzes and a shaft 220 feet in depth. On the north side of the bluff are four adit levels; they all intersect the north or Knowlton vein, and the two upper cross-cut levels are driven in



LONGITUDINAL SECTION OF THE KNOWLTON MINE, JAN., 1881.

Scale, 180 ft. to one inch.



400 feet, to the Butler or Champion vein. There are two shafts, 120 feet apart, down in the Champion vein 250 feet, and drifts from these each way, 200 feet. The shafts are connected by two levels. This mine is at the west end of what is known as the Evergreen range.

On the Flint Steel location two mines have been opened at points several hundred feet distant from each other. The more important one is opened with three shafts sunk to the second level, and these shafts were connected. One mass of 35 tons was found in this mine in 1865, in which year 152 tons of rough copper were taken out. The adits in the Caledonia from the north side were driven in on cross courses, and in one of them three masses of copper were found—the only instance in Ontonagon county of finding copper in fissure veins. In the Norwich and other mines long drifts have been made in these transverse fissures without finding any copper.

The consolidation of the two companies was made through the fact that the same parties owned the controlling interest in both. Immediately after, a stamp mill with 24 heads was built on the Flint Steel river, between the two mines, and a long trestle was made, extending from the mill across the valley each way, north and south to the mine. About $60,000 were expended in this work. The purpose was to work up the burrows of rock which had accumulated in the previous year's working, especially since the mines had been worked on tribute, and which were thought to contain a good percentage of copper. The rock on top of the burrows looked well, but unfortunately it proved that the rock on the surface of the burrows was the only part that held any copper. As soon as that was worked off, the remainder, the bulk of the piles, was worthless, and the mill had nothing to do. The mines, which carry but little stamp rock, could not supply the mill, and it was obliged to shut down. This work was done under the immediate superintendence of Dr. McKinnie, who was one of the chief owners, and the doctor was, naturally, greatly disappointed. For several years the mill has not been used, and the trestle is becoming dilapidated. In 1873, after the company shut down, the mines were leased to Capt. Martin—an old experienced miner—on a royalty, and during the six years that he has held the lease he has obtained 135¾ tons of copper. His product for 1880, taken from the Caledonia, is 33,911 pounds of mineral in mass and barrel copper. The stamp rock has been allowed to accumulate. The period of his lease is eight years. Captain Martin has paid his miners six to eight cents per pound for getting out the copper. The company have realized enough to pay the taxes. He has had, on an average, six men at work. During the past summer four men have been working on the out-crop of the Champion vein, on the top of the Caledonia bluff, in an old Indian pit, and obtained 16 tons of copper, in which was a 4-ton mass. Recently he has set 2 men at work in the Flint Steel mine, and they got out 2,250 pounds the first five weeks. He once found a 40-ton mass in one of these pits on this location.

On the Caledonia location are 14 houses, and there are 11 houses on the Flint Steel. The mining work done on these locations was never very systematic. It has been done at different times, off and on.

Walter Furguson, Secretary and Treasurer; office, 35 Pine street, New York. Stephen Martin, Agent, Greenland, Mich.

THE KNOWLTON MINING COMPANY.

Adjoining the Flint Steel (Caledonia) on the east is the Knowlton mine, The company was organized in 1853. The mining location comprises 600 acres. situated on Secs. 1, 2, and 12, T. 50, R. 39. The mine is located on the S. E.

¼ Sec. 1, and is opened in the Knowlton vein, which has a length in the property of 1,100 feet. The vein bears N. 35° E., and dips about 33° with the horizon to the northwest. Its width varies from two to twelve feet. The matrix of the vein is epidote, quartz, calcite, chlorite, etc. The dip of the vein carries it into the company's land.

The mine, which is now idle, was opened in 1862, and the extent of the underground openings comprise three shafts—No. 1 and No. 2 sunk to the fourth level, and No. 3 to the third. The shafts are connected at each of the levels with drifts.

The depth of the mine is 240 feet below the surface on the lay of the rock, and the extreme length at which the vein has been opened is 600 feet.

A stamp mill with eight heads was erected in 1864. Nos. 1 and 2 shafts were worked with an engine and winding drum. For several years the company worked about 40 miners, built about 20 dwellings.

The total expenditures of the company to the close of 1864 was $217,978.81, and the assessments had been $110,000.

The product, 1862, 37,040 pounds ingot = 62 per cent of the mineral; the product, 1863, 85,451 pounds ingot = 62¾ per cent of the mineral; the product, 1864, 122,877 pounds ingot = 61 per cent of the mineral.

The agent, up to 1865, was Mr. J. B. Townsend, agent of the Minesota, and it would seem that the outlay for surface improvement, etc., was too large in proportion to the extent of mine opened. The company expended $400,000, $160,000 of which was derived from assessments. Work was discontinued on company account in 1866–67, and until the past year it has since been worked on tribute, producing each year from three tons to 45 tons of copper.

Product in 1872 was 11 tons, 1,300 pounds mineral; product in 1873 was 45 tons, 837 pounds mineral; product in 1874 was 3 tons, 775 pounds mineral; product in 1876 was 2 tons, 622 pounds mineral; product in 1877 was 4 tons, 532 pounds mineral; product in 1878 was 6 tons, 1,102 pounds mineral.

Captain Dunn resides at the mine, and has the care of the property.

MASS MINING COMPANY.

The Mass mine is now the largest producing mine in Ontonagon county, having been brought up during the past five years, under the efficient management of Benj. F. Chynoweth, the agent, to its present flourishing condition.

The success of the Mass develops the possibilities of the series of small mines which make up the Evergreen range, of which the Mass is a member. This range is the northeasterly extension of the Minesota south bluff, and begins on the north side of the Flint Steel gap and is occupied by a succession of mines, beginning with the Caledonia, followed by the Knowlton, Mass, Ogima, Evergreen Bluff, Ridge, etc. This range has an elevation above the lake of about 800 feet, and above the head waters of Flint Steel river, which runs along the southerly base, of about 200 feet. It is coursed by five prominent known veins, which run with the formation and conform to its dip, having a general bearing of N. 37° E., and a northwesterly dip with the horizon of about 44°.

These veins are generally from 100 feet to 300 feet apart, and are named from the location where they were first opened or from the individual who first discovered them. In the order of succession they are now called: The southerly one, the Evergreen vein; the Ogima, the Butler or Champion vein; the Mass and the Knowlton, the latter being the most northerly.

The Mass mine location, S. W. ¼ of Sec. 6, T. 50, R. 38, is crossed by all these veins. The company was organized under the general mining laws of

this State, March 31, 1856, with the president, then as now, Dr. C. G. Hussey, Joseph M. Cooper, Secretary and Treasurer. The other officers, Messrs. Avery, Howe, Clark, etc., all of whom whom were associated in the organization of many of the early copper companies on Lake Superior, some of which, as the Cliff and the National, are among the widest known and most profitable.

The first shipment of copper, eight and one-fourth tons, was made in 1857, the year following the commencement of its operations. Work here was prosecuted moderately until 1860, when it was suspended, and continued idle until 1864, at which period prices ruled at a height that induced the resumption of work in many such mines.

Prior to 1864 a tunnel had been driven in on a cross-course from the northerly side of the bluff to intersect the veins, which were drifted and stoped out to some extent. The tunnel reached about half way through the bluff, and two air shafts had been sunk to intersect it. In driving this tunnel it was found that the formation had been heaved or thrown at this fissure, the dislocation of the veins amounting to 25 feet, and that the air shafts had been sunk between the dislocations.

On resuming operations in 1864, work was begun on the Evergreen vein in the southerly side of the bluff. In this vein six shafts were sunk, varying in depth from 60 feet to 112 feet, making a total length of 501 feet, which work was done at a cost of (average) $30.75 per foot, and the levels connecting these shafts comprised a total amount of drifting of 719 feet, representing an average cost of $17 per foot. But in the spring of 1865 it was determined to discontinue work on this vein, it appearing that no large return could be got without a greater outlay for machinery than the company felt willing to make. The mining work was therefore transferred to the veins intersected by the adit level, and here it was continued until 1868, when all work was again totally suspended. During the succeeding six years some irregular tribute work was done, by which a total amount of 38½ tons of copper were obtained.

In 1874 it was determined by the company to resume work again, and the affairs were placed in charge of Capt. John Chynoweth, who in the following year resigned, and his son, B. F. Chynoweth, was chosen agent. The latter's practical and theoretical training under his experienced father at the National, and in the engineering school at the university, admirably fit him for performing successfully the important duties of superintendent of a mine.

The purpose has been to proceed cautiously, avoiding all unnecessary expenditure, and to make only such surface improvement as was justified by the production. It was determined, if possible, to make the mine at least pay its own way, without calls upon the stockholders for funds.

The board of directors in 1874 inaugurated their plan to develop the mine, and levied an assessment of $1 per share, by which $14,195 were realized. From this time to 1876 there was opened, in the Knowlton vein, 220 feet of drifting, and 16 cubic fathoms of stoping, done at an average cost, for the former, of $12.87 per foot, and for the latter, $21.50 per fathom. In the Mass vein 65 feet of drifting had been done, and 16 cubic fathoms of stoping, costing respectively $14 and $22 per unit of measure. In the Champion vein drifting was done to the amount of 81 feet, and stoping to the extent of 14 fathoms. A shaft had also been sunk in the Mass vein 81 feet in depth. The average number of men which had been employed was 25, and the mine had yielded 30,215 pounds of copper, 2,600 pounds of which had been obtained from the Knowlton and Champion veins during the winter of 1875-76.

The Knowlton vein has a width of about eight feet and is thought to be the

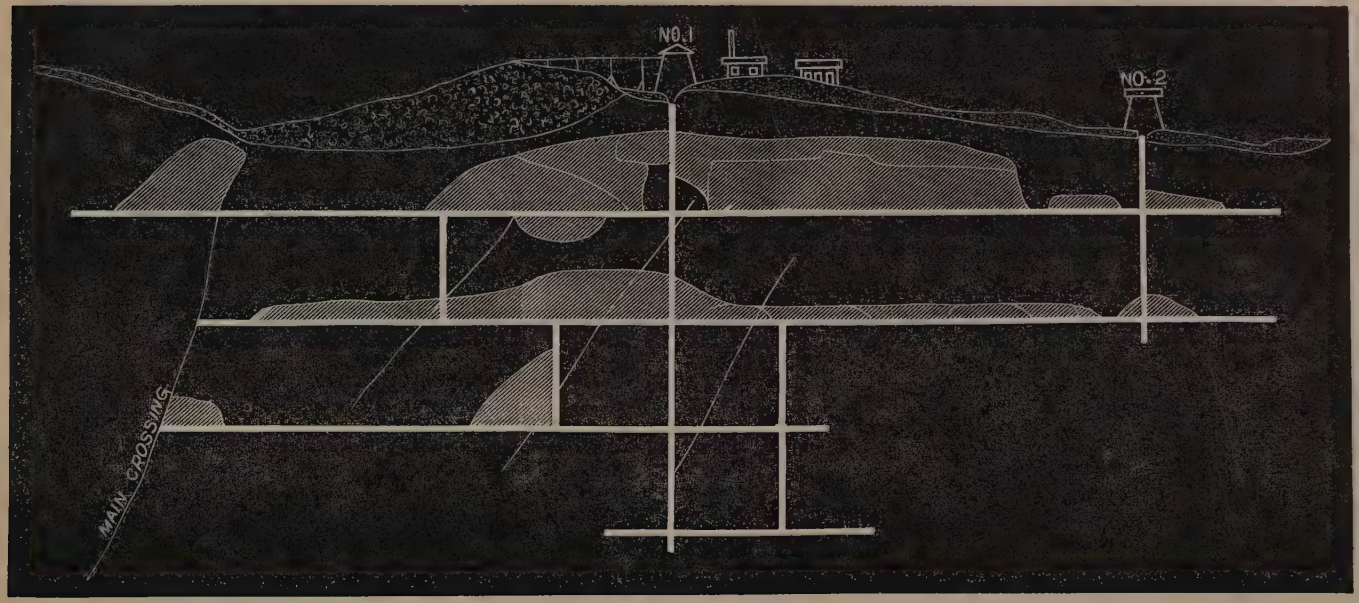
most valuable of the Evergreen range lodes; the matrix is quartz, epidote, calc, spar, and diorite; and next to it in importance is thought to be the Mass vein, lying 140 feet south of the former. The Champion is a wide, metalliferous lode, lying 300 feet still further to the south. It it is composed of vein trap, with crystals of epidote, laumonite, calcareous spar, etc. The copper occurs in masses, and there is little or no stamp rock in the vein. Still further to the south 100 feet, lies a belt of vein matter 40 feet wide, known as the Ogima vein, from having been first opened in that location. Some years ago an opening made in this vein on the Mass property revealed a 5-ton mass of copper. This vein has been but little explored on the Mass location, but in the adjoining location on the east, it furnishes the basis of the entire operations.

The Evergreen vein is the last prominent one intersected by the cross cut, and lies 230 feet south from the Ogima lode. It has a variable width of from two to fifteen feet, and the vein matter is an amygdaloid trap with crystals of epidote, quartz, and calcite. In some of the other locations, notably the Evergreen bluff, it yields mass and barrel copper, and some stamp rock. Its out-crop shows many ancient diggings and tribute workings; but at the Mass the results from working it were not sufficiently favorable to justify a continuance of the work. The Knowlton seemed to afford a greater proportion of stamp rock, as well as being equally productive in mass and barrel-work. During the past four years most of the work has been done in this lode. The tunnel was completed through to the south side of the bluff, 1,400 feet, and in crossing the Champion vein an 8-ton mass was found. The bottom of the tunnel was laid with T rail, with branches running into the drifts in the several veins. A stamp mill was built in the latter part of 1877, supplied with 16 heads of stamps, Gates pattern. The mill is placed on the Flint Steel river, which runs through the valley south of the bluff, and below the stamp mill a saw mill was erected, run from the stamp engine. The rock found its way to the mill from the south end of the tunnel down a chute 240 feet into cars, which conveyed it on a track 1,000 feet in length to the stamps. Added to the product of the mine was the accumulated stamp rock of the previous years of working. The mill is supplied with water from a pond above, made by a dam across the stream, and is forced up by a 15-inch pump,—a steam pump is provided in case of fire. The main shaft in the Knowlton vein was fitted with a skip road, and worked with an engine and winding drum.

At the present time the rock is hoisted into the rock house directly from the shaft, where it is overhauled, the masses sorted out, and the large portions of rock placed under the hammer, which is a cylinder of iron that works in a frame similarly to a pile-driver. This hammer breaks up the rock to a sufficiently small size for the Blake's crusher, into which it is thrown, and thence dropped into the shute, out of which it is drawn into the cars that convey it along a horizontal track 1,200 feet in length to the top of the bluff, where during the past year a double-track inclined railway has been built, down which the loaded cars are sent to the stamp mill, the descending car drawing up the empty one. The height of the bluff is about 200 feet, and the distance to the mill is 1,350 feet. Since commencing to operate the incline the way by the tunnel is no longer used. The washing apparatus used is Schierman's and additional facilities are soon to be added, together with eight more heads of stamps. Even although there is not a great amount of stamp rock, still the rock is extremely hard and so entoughed with copper that the process of stamping is necessarily slow. There is a great lack of water in dry time, and much trouble in holding it in wet time. The rock is not calcined.

LONGITUDINAL SECTION OF THE MASS MINE, JAN., 1881.

Scale, 120 ft. to one inch.



The present work is done in the Knowlton vein, but it is intended, however, to continue work in the other veins as soon as the requisite mining force can be secured and provided for. The vein is bunchy and exceedingly irregular in direction and in dip. Its width varies from four feet to forty feet. The best deposits are found where the sharpest folds occur. Where the vein is very wide much barren rock is found, necessitating much dead work, possibly one-quarter of the rock found in these wide places being fit for the stamps; but when the vein is narrow, not exceeding four to six feet in width, 75 per cent of the rock proves profitable.

During the past year considerable expense has been incurred for improvements. A few dwellings, warehouse and barn have been built, an iron lathe added to the machinery, the new tramway and incline built, etc., causing a total expenditure of upwards of $80,000; but the mineral product—360 tons, yielding 75 to 80 per cent, at the present price of 19 cents—will still leave a small margin of profit in the year's work. It is expected that during the coming year but little money will have to be laid out in the way of improvement, and with the present favorable indications to be seen in the mine there is every reason to expect, under its present efficient management, the mine will make a good measure of profits. The purchase by the Mass of the Hazzard mining location, being the N. E. ¼ Sec. 1, lying north of the Knowlton, was recently made.

The average number of miners now employed is 60. The total expenditures to close of navigation 1880 are $379,884.55, and the total receipts have been about $387,884.55. The total amount of the assessment which has been paid is $149,202.00. The total amount received for copper is $292,531.17. Total expenditures to date, December, 1880, $437,705.93. Cash on hand, $4,027.24. Assets, $24,591.69. Percentage of rock rejected, 40 per cent.

The number of tons stamped is 7,779, which yielded 40 pounds of mineral per ton. Number of tons stamped per head per 24 hours' work was 2.

Cost per ton, sorting, tramming, stamping, washing, $1.40. Cost per foot for sinking shafts, $19.90. Cost per foot for drifting levels, $12.96. Cost per fathom for stoping, $34.00. Yield of mineral per fathom, 1,050 pounds.

The officers of the company are C. G. Hussey, President, Jos. W. Brown, Secretary and Treasurer, Pittsburgh, Pa. B. F. Chynoweth, Agent, Greenland, Mich.

OGIMA MINING COMPANY.

The Ogima mining location comprises the N. W. ¼ Sec. 6, T. 50, R. 38. It joins the Mass on the north, and is crossed by the Evergreen, Ogima, Champion, Mass, and Knowlton veins. A cross section of the Ogima bluff extending from the surface line to the adit level shows the occurrence of seven distinct mineral lodes, at distances, measured from the north to the south, on the adit level, 150 feet from the mouth of the adit to the Knowlton, then 228 feet to the second lode, 50 feet to the third, 80 feet to the fourth, 65 feet to the fifth, 42 feet to the sixth, 290 feet to the Evergreen lode, and 105 feet to the south side of bluff—total distance through the bluff, 951 feet. The veins here were worked on the surface by individuals, or tributers, cleaning out the old Indian pits, and obtaining small masses and barrel-work copper, until 1860, when the company was organized under the general mining laws of the State with a capital stock of $500,000, and mining work was begun in the Ogima vein. Previous to 1860 there had been taken out and sold, of tribute copper, 115,000 pounds of ingot. The miners found themselves and received $140 per ton.

There was also some accumulation of stamp rock, for which there were no facilities for working up. The company shipped in 1861 20,000 pounds of mineral, yielding 14,000 pounds ingot copper. In 1862 there were produced 58,000 pounds mineral, yielding 70 per cent = 40,600 pounds ingot. In 1863 38,000 pounds mineral, yielding 75 per cent.

During these years considerable surface improvement was made,—agent's house, miner's dwellings, etc., and in 1864 a stamp mill was built with eight heads of Gates' stamps, run with an engine of suitable power, also two portable engines for hoisting and pumping were rented. The stockholders were called upon for assessments to the amount of $140,000. This in addition to the receipts for copper produced. The stamp mill is built on high ground, and the water pumped from a small pond that seems scarcely large enough, under ordinary circumstances to swim a flock of ducks in. It is formed by damming a small rivulet that runs along the valley in wet weather on the north side of the bluff.

The company stopped work in 1868. The underground workings comprise three shafts sunk,—No. 1 and No. 2 to the 4th level, and No. 3 to the first level. The first two are connected by drifts at all the levels, and the veins are crossed by an adit tunnel through the bluff. Since the pumps ceased, in 1868, the mine has been filled with water to the adit level, and above that the ground has been worked off and on by a few tributers.

In 1879 there were taken out by tributers 13 tons, 751 pounds ingot copper; and in 1880, 58,650 pounds mineral, yielding by estimate 70 per cent ingot.

There now remains on the location, the stamp mill and machinery, hoisting engine, agent's house, barn, etc., and 11 miners' houses. The tributers are paid seven cents per pound for the copper which they get out.

A few years ago the directors made a dividend of $15,000 from an idle surplus lying in the treasury. Office in New York; Samuel Cooper, Secretary and Treasurer; L. Collins, Agent, Greenland, Mich.

THE MERRIMAC MINING COMPANY.

Adjoining the Ogima on the north is the Merrimac mine, comprising the E. ½ Sec. 34, and the S. ½ S. E. ¼ Sec. 27 (400 acres), T. 51, R. 38. The property was set off from the Bohemian estate in 1863, when the company was organized, the shares being distributed among the Bohemian stockholders. Assessments were made and collected to the amount of $117,900, which was expended on surface improvements, and in doing a small amount of mining work on the S. E. ¼ Sec. 34. A store and ten boarding and dwelling houses were built, and a hoisting engine procured.

The Evergreen vein probably dips under this property, but the explorations were never conducted sufficiently to determine the extent and character of the mineral veins which cross the location. Two shafts were sunk on the Ogima vein, and a shaft started to reach the Evergreen vein, but was only carried down about 80 feet and abandoned. The property is now advertised for sale. The houses are occupied by miners working in the adjoining locations.

Joseph G. Henszey, President; office, 110 Front street, Philadelphia. Alfred Meads, Agent, Ontonagon, Mich.

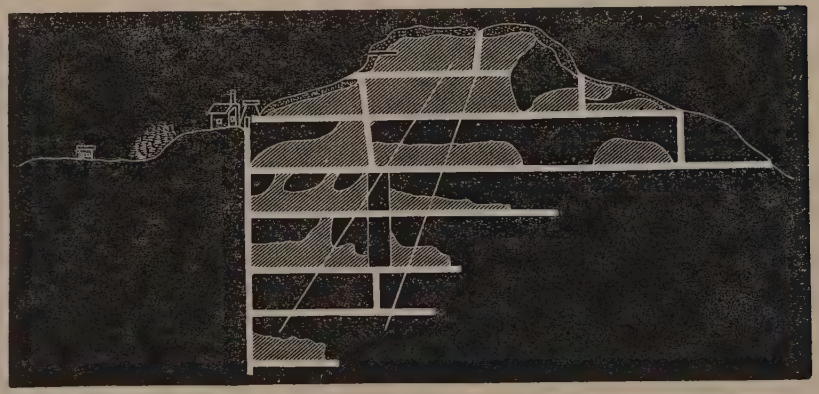
THE EVERGREEN BLUFF MINING COMPANY.

This mining property adjoins the Mass and Ogima on the east, and the Ridge on the south, and comprises 680 acres—the E. ½ Sec. 6, N. E. ¼ Sec. 7, and W. part of Sec. 5, T. 50, R. 38. The northeasterly continuation of the veins,

LONGITUDINAL SECTION OF THE EVERGREEN BLUFF MINE,

ONTONAGON COUNTY, MICH., 1881.

Scale, 250 ft. to one inch.



which pass through the Mass and the Ogima, cross the northeast ¼ of Sec. 6, and it is on this portion that the mining work has been done.

The company was organized in 1853, and the stock was all owned by a few Michigan men, in Detroit and Pontiac. Mining work was immediately begun on the south or Evergreen vein, and continuously prosecuted with a force of from 6 to 28 men, until 1857, when work was suspended for about a year, and again resumed and continued on about the same manner, with the addition of a small hoisting engine, until 1863, when a majority of the stock having been bought by parties in New York, the office of the company was removed from Detroit to that city, and operations were carried on for a few years thereafter on a greatly reduced scale. Up to 1863 the underground work in the mine consisted of an adit driven in the vein 511 feet, and four levels below this of respective lengths of 311 feet, 321 feet, 360 feet, and 50 feet = 1,553 feet in all, and three shafts—240 feet, 60 feet, 240 feet, respectively, = 540 feet in depth. In addition, some work had been done on another vein, consisting of driving a cross-cut 210 feet, and sinking a shaft 80 feet.

A small branch of the Flint Steel cuts through the bluff near the northeast corner of Sec. 6, and exposes the veins and the rock formations upon the opposite faces of the gap, which is thus formed; further to the south is a second depression, and in the south wall of the depression which forms this second valley, the adit is made to enter.

On this branch of the Flint Steel river a stamp mill was built in 1862, provided with 16 heads of stamps, worked with an engine.

The total product of the mine up to the close of 1862 was 208 tons of refined copper, 141 tons having been produced during the preceding three years. The product for the different years up to this time was as follows:

YEAR.	No. of Masses.	No. of Barrels.	Barrels Rough Copper.	Per Cent Yield.	Pounds of Refined Copper.
1854	1	5	3,148	76	2,599
1855	10	28	21,763	65.5	14,007.5
1856	16	41	36,687	68.5	25,110
1857	35	73	69,198	68	46,942
1858	--	13	9,440	70.5	6,665
1859	20	55	54,198	71.3-5	38,811
1860	20	78	83,791	76	63,817
1861	53	114	141,221	70.5	99,187
1862	48	124	163,436	72.96	119,257
1863	--	---	144,211	74	105,746

The total proceeds from sales of copper had been $86,582.24, and the total expenses had been $223,562.89, and the total assessments, $108,000.

In March, 1863, the new board of directors assumed control; the mining force was increased to 65; Gates' stamps—16 heads—were put into the mill; new hoisting engines erected; a large number of new houses built, store, shops, etc. The company continued operations on a somewhat extensive scale, with Q. C. Patterson as agent of the mine, and obtaining about 300 tons of copper per year, until 1870, when work was suspended. The expenses were all the while in excess of the product, and exceeded their expectations. Despairing of making of the undertaking a success, the stockholders resolved to quit, and the only mining work that has since been done is by tributers, and very little

of that until 1878, at which time the property was put in charge of Mr. L. Collins, who occupied the store building and the agent's house.

The mine was filled with water up to the adit level, and the tributers have worked above that. Mr. Collins pays them seven cents per pound, and makes some advances in the way of supplies.

In 1878 the product of mineral was 46 tons, 1,467 pounds, and 1879 it was 20 tons, 1,588 pounds. In 1880 there has been produced 13,470 pounds of mineral, which has heretofore averaged 80 per cent in refined copper.

There are five engines on the premises, in place. Some of the houses are occupied by tenants who work in this or in other mines. The property is in charge of Mr. L. Collins, who lives on the location. The general office is in New York; F. W. Capron, Secretary and Treasurer.

THE RIDGE COPPER COMPANY.

The Ridge mine is situated in a prominent bluff, which forms a ridge transverse to the trend of the range, made by the valley, which lies between it and the Evergreen Bluff mine on the south, and the gap of the Flint Steel branch on the north. The location consists of the S. W. ¼ Sec. 35, T. 51, R. 38, and the company is one of the oldest in the district, and has made one of the best records as a mining enterprise of any company in the Evergreen range.

The organization was made under a special charter from the State of Michigan, April, 1850, with Luther W. Clark as President, Justin Shapley, Secretary and Treasurer, and six directors. The property was purchased for the sum of $800, and is distant from Ontonagon harbor 13 miles. The first meeting of the stockholders was held at Eagle river, October 9, 1849, and work was begun on the location on the 18th of the same month, and by July thereafter some houses and a blacksmith shop had been built, and near the center of the location, in a gorge at a point about 100 feet below the summit of the ridge, an adit had been driven in on the vein a distance of 85 feet, and one and one-half tons of copper taken out. Here, as elsewhere in this region, were numerous Indian diggings, by following which the outcrop of the veins was plainly indicated.

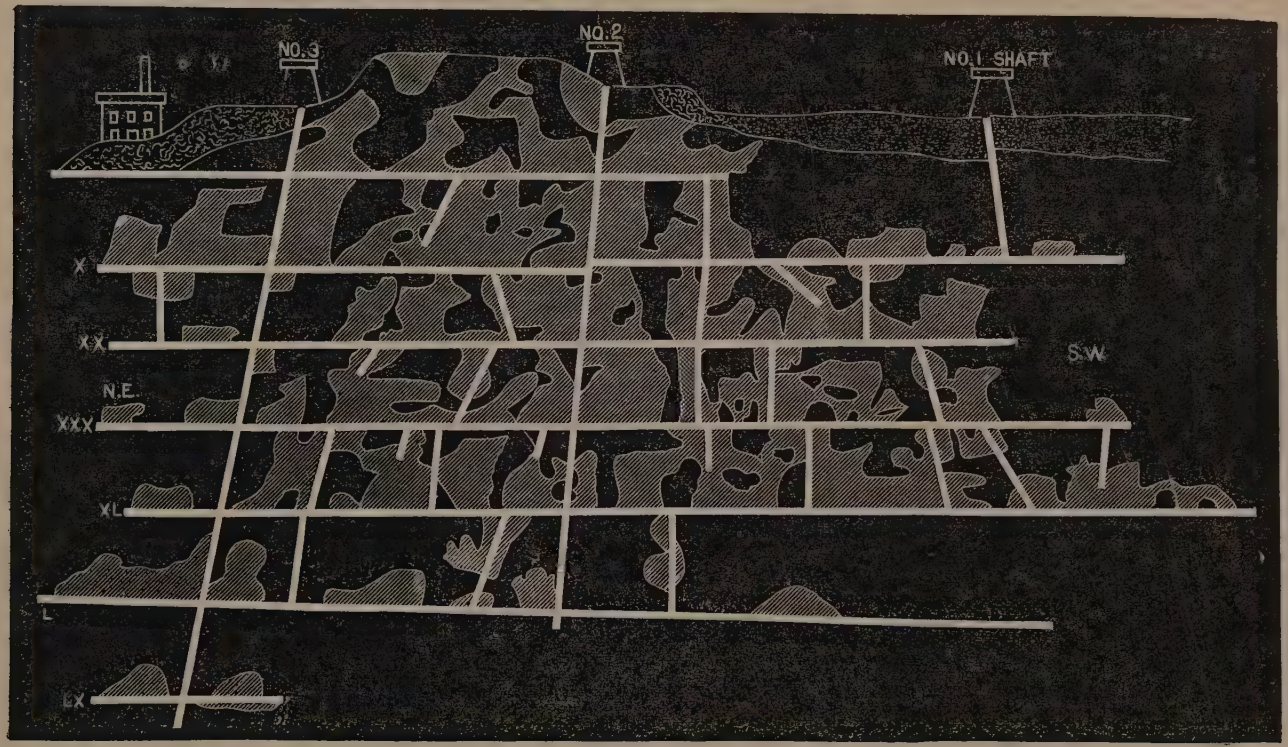
The first mine was opened in the Butler or Champion vein, and in this lode two shafts were sunk to the 70-fathom level, and considerable drifting done at each of these lifts.

The old company continued work for five years, and in 1855 leased the mine to Capt. Stephen Martin, who worked it on his lease until 1860, when the property was purchased by Thomas F. Mason for $200,000. Captain Martin continued to work the mine from year to year until 1863, when a new company was organized under the general mining laws of the State, with a capital stock of $500,000. Work was resumed by the new organization, and assessments to the amount of $200,000 was made during the two succeeding years, since which time the mine has produced sufficiently to meet the expenses, and in 1872 the product was 170 tons, 920 pounds—78 per cent purity; the net earnings were $87,119.54, and the expenses $58,780.98, giving a profit which, with the surplus previously accumulated, enabled the directors to declare the first dividend of $50,000. The product of rough copper was:

Year.	Tons.	Pounds.
1873	160,	-----
1874	282,	342

LONGITUDINAL SECTION OF THE RIDGE MINE, JAN., 1881.

Scale, 180 ft. to one inch.



Year.	Tons.	Pounds.
1875	218,	650
1876	196,	465
1877	200,	1,085
1878	162,	317
1879	132,	505
1880	132,	430

Average, 72 per cent.

The total dividends paid are $100,000, the last one being 50 cents per share, declared January, 1880. It is expected that the business of the present year will give a like dividend.

The stamp mill has 12 heads, but four more are soon to be added, and the present imperfect washing apparatus will be changed to Schierman's. There is great lack of water, the small stream affording an insufficient supply in dry weather. It is economized to the greatest possible extent by the use of two dams. The mill is connected with the kiln house by a railroad which crosses the valley, laid on trestle work. No. 2 and No. 3 shafts are furnished with skips, and are worked with engine and winding drums, by which the rock is drawn up in the skip cars and dumped into the shaft houses, where it is sorted, and the stamp rock trammed to the kiln house to be roasted. The mine is now furnishing more stamp rock than heretofore. Formerly about 80 per cent of the rock was rejected, but at present the result is a little better. In 1879 the selected rock was 19.25 per cent of the total amount; in 1880 it is 21 per cent. The yield of the rock stamped in mineral is 1.15 per cent, and the average per cent of the mineral in ingot is 72 per cent. There are now 42 miners employed. Since 1871 the mine has been under the charge of Capt. Samuel B. Harris, a miner of much experience and unquestioned skill, and the present prosperous condition of the company's affairs are no doubt due to his excellent management.

The vein bears S. 43° W., and dips northwesterly 38°. The longitudinal section will show the underground working at the present time, and the accompanying ground plan may serve to convey an idea of the contortions and twistings, and variations in width, which characterize the lode. In the 10th level, near No. 2 shaft, an instance occurred in which the men drifted entirely around a great "horse" of trap, and in lieu of progressing ahead in the vein, as they supposed that they were doing, they found themselves, in due time, much to their surprise, "holing" at the starting point, accompanying what is designated as a "whim around." The company now owns 1,494 acres.

The officers are Thomas F. Mason, President; W. Hart Smith, Secretary and Treasurer, No. 4 Exchange Place, New York; S. B. Harris, Agent, Greenland, Mich.

THE ADVENTURE MINING COMPANY.

The Adventure is one of the earliest mining organizations in the Ontonagon district, and was one of the undertakings of the old Pittsburg and Boston company. It began in 1850 under a special charter from the legislature of Michigan, with a capital stock of $200,000, divided into 1,000 shares. The officers were: C. G. Hussey, President; James M. Cooper, Secretary and Treasurer, and five directors; office in Pittsburg. The mine adjoins the Ridge on the north and east.

The name of the company was properly assumed; the mining work has been

a series of ventures in searching for mineral, which seems to be disseminated through the trap without being anywhere confined to a single vein, and after four years unsuccessful endeavor to establish a systematic mine they decided to adopt the policy of mining their irregular deposits by the tribute system, which method they were the first to introduce.

More or less irregularity is apparent in all the mines in the Evergreen range, but in the Adventure bluff the mineral is principally found in pockets or bunches, having a general traceable direction, but without being in well defined veins, and determined by inclosing walls. Shafts and levels in any regular order and succession are out of the question.

Accordingly, after having, during several years' work, punctured the bluff in various places with trial shafts, the agent was instructed in May, 1855, to allow the men to work at designated points, and to pay them $100 to $120 per ton for all the mineral they could obtain, the mineral to be 50 per cent pure copper; the men to find themselves, except the company should furnish a smith to sharpen their tools. The product for the season thus obtained was 78 885-2000 tons of mineral which, smelted, gave 31 1253-2000 tons ingot copper, and sold for $13,903. The number of tributers thus engaged was 55. The cleared land was also leased out on shares. A stamp mill with eight heads, run by water, was built during the summer of 1855, and a railway track, extending from the mine to the mill, was made, the cost of the whole being $2,500. The stamp mill was found to add to the product three or four tons per month.

In 1856 the product obtained was 140 tons of mineral. The product for the previous years was 120 tons of mineral, yielding about 72 tons of refined copper.

The total expenditures to 1856 were $136,407.83, of which amount $90,000 were derived from assessments.

The company proposed to continue the tribute work so long as it could be made to meet the expenses, in order, if possible, to develop some regular deposit. The company purchased, in 1858, the Merchants' Company's property adjoining the Adventure, being the N. W. $\frac{1}{4}$ Sec. 35, T. 51, R. 38. The stamp mill was also provided with steam power.

In 1870 the whole property was sold to Thomas F. Mason for $110,000, and a new company was organized and began work with about a dozen miners. An adit was driven from the north side of the bluff to intersect the lodes, a distance of 600 feet, and 150 feet of drifting done in the Champion lode. And also a shaft was sunk in 1875 to a depth of 385 feet. No work has been done by the company since 1877, but during the three years that have elapsed the tributers have raised 98,464 pounds of copper. The tribute product for 1880 is 3,140 pounds of mineral. The property is owned by the same parties who control the Ridge mine, and the plant that was of any value has been transferred to that location. The total assessments made by the new company are $100,000. The location comprises 480 acres.

President, Thomas F. Mason; Secretary and Treasurer, W. Hart Smith; office, Exchange Place, New York; Agent, S. B. Harris, Greenland, Mich.

HILTON MINING COMPANY.

This location adjoins the Adventure on the east, and comprises the E. $\frac{1}{2}$ of Sec. 36, T. 51, R. 38. The company was first organized in 1863, and sunk a few trial shafts, and made some effort to find the veins which cross this land.

There are seams of epidote and quartz, which appear to contain but little copper.

The location was abandoned until 1863, when the company was reorganized as the Hilton, having been formerly termed the Ohio. Mining work was again prosecuted for two years, and in 1865 it was definitely suspended.

The underground working consists of two shafts down about 100 feet each, connected with an adit that comes out on the west side of the bluff, its total length being 350 feet. The only hoisting apparatus ever used was a horse whim or man power.

There is no water on the property for stamping purposes. The vein in which the mining was principally done has not been identified. There are several houses, change house, smith shop, etc., on the location. A few tributers have occasionally worked in the mine since 1865, and in 1878 9,489 pounds of mineral were thus got out, and 1879, 2,261 pounds, yielding about 72 per cent of ingot copper. General expenses to present time, $45,000; assessments to date, $50,000.

Thomas F. Mason, President; W. Hart Smith, Secretary and Treasurer; office, Exchange Place, New York; S. B. Harris, Agent, Greenland, Mich.

AZTEC COPPER COMPANY.

The Aztec lies east of the Hilton, the N. W. ¼ Sec. 31, T. 51, R. 27, and the bluff, which runs nearly east and west, and is locally known as the Aztec bluff, being one of the series which make up the Evergreen range. The bluff slopes to the north and to the south about equally, the rise being 200 feet. The mineral veins run east and west parallel with the slope, and dip about 44° to the northwest. The location takes its name from the unusual amount of ancient mine work, with which the surface was indented; this ancient work being attributed by many people to the Aztecs. In these pits on this location considerable copper was obtained—in some instances in masses of large size. In one pit a mass of 100 tons weight was obtained. This work of clearing out the old pits for copper was mostly done by tributers. The same trouble was experienced here as at the Adventure and at other locations in this part of the range, in regard to the uncertainty and disordered state of the deposits of copper. The prosecution of mining operations in the most judicious manner was a difficult and puzzling task. It has been impossible to find regular veins that continued such to any considerable distance. Short veins, feeders, and fissures are often traced. The first copper was shipped in 1852—6,757 pounds of mineral = 3,381 pounds, which sold for $840.44. In 1853 the product was 20,435 pounds = 8,826 pounds ingot, which sold for $3,383.02. At June 1, 1854, $30,000 had been expended. The owners were the Pittsburg and Boston men—C. G. Hussey, T. M. Howe, J. M. Cooper, etc.

The foot wall or underlying rock is a grayish colored trap, and the overlying, hanging wall being a dark colored trap.

It is a part of the purpose of the present work of the company to determine the clearage walls—the walls of the veins. A tunnel is driving to the north from the bottom of No. 1 shaft, which will be continued until it strikes the dark, unproductive trap—"country rock." When this line is reached they will know that they have attained to the limit in this direction.

Two short adits have been driven in from the south side, the lower one 175 feet, the upper one 80 feet. On the north side an adit is driving in to reach

the Knowlton vein; it is in 175 feet, and it is expected in a short distance further to reach the vein.

The bluff is about 1,000 feet through at the base. There are two shafts down in the south vein, 300 feet apart, which are connected by levels, and sunk to the 60-fathom level, but the vein is so irregular that it has been impossible to determine its outlines. Possibly the developments which will be made in the course of the work now pursued will enable them to reach something definite. From the points of intersection of the adits with the veins levels are driven east and west, and also sinking has been done to 60 fathoms below the adit level.

On the Knowlton vein it is proposed to drive an adit beneath the Indian pits, some of which have proved so rich in copper, hoping that the product, which was so great, has not been exhausted, and also to reach those portions of the upper part of the vein which were overlapped by the trap, and have not as yet been reached. The improvements are a stamp mill with 10 heads of stamp, situated to the south of the slope, rock house, with Blake's crusher, etc., and house room sufficient for 100 men. The mine has the advantage of being easily drained by adit levels to considerable depth. The company own 1,200 acres of land two or three miles distant from the location, convenient for fuel. The assessments have been $150,000.

In 1871 the mine was bought by P. T. Rogers, by whom it was sold to Dr. Hussey, and a new company was organized in 1880—July—and the mine placed in charge of Capt. John Chynoweth, to work. Capt. J. Huddlestone is now at work with about six miners, and has taken out, since he began work in September, 8,000 pounds of mineral.

The capital stock is $1,000,000; office, Boston; August A. Page, Secretary and Treasurer; Capt. J. Chynoweth, Agent, Greenland, Mich.

BOHEMIAN—INTERNATIONAL MINING COMPANY.

The location of the Bohemian mine is the E. ½ of Sec. 31, T. 51, R. 37, adjoining the Aztec on the east. Work was begun here in an early day, and the first shipment, consisting of about one and one-half tons of pure copper, was made in 1853. It was found difficult to trace the existence of any regular vein. The first shaft was sunk on what seemed to be one, inclining to the north at an angle of 33°. The earliest explorations were made by the Piscatauqua Mining Company, who in 1853 sold out to the Bohemian Company for $3,000. The latter company continued to hold the property, doing a little work during the first few years, until 1862, when a reorganization was made. Up to the time of this reorganization there had been expended in mining on the location the sum of $181,985.90, $13,320.17 of which was derived from the sales of copper; the balance by sales of stock and assessments. The estate comprised 1,480 acres.

The Bohemian Mining Company was organized under a special charter granted by the legislature of the State of Michigan, March 27, 1848. The capital stock was placed at $250,000, divided into 20,000 shares.

Upon the resumption of operations in 1862 additional assessments were called in, and mining work begun in 1863 on an enlarged scale. Among the many improvements that were made were a saw mill, a stamp mill containing 12 heads of Gates' stamps, and a number of houses. Work was continued until 1866, when the mine shut down until 1870, when work was resumed and

prosecuted during a short time. The veins run east and west, and extend for one-half mile on the property, having a variable width of from 2 feet to 15 feet and upwards, and a dip to the north of about 40°. The underground work comprises two shafts, sunk to respective depths of 210 feet and 260 feet; four levels extend from these shafts. The first or adit level having a length of 450 feet; second level, 480 feet; third level, 400 feet; fourth level, 430 feet. Shaft No. 2 is fitted with a skip and with turn tables at the several levels, to send the same cars that tram in the levels to the surface. Other openings have been made on other veins lying to the south and to the north of the principal mine, the openings on the north being connected by a cross course adit with the main mine. Considerable money has been expended and considerable work done on the location, but with poor success. About 220 tons of refined copper have been obtained, all told. The stamp mill was burned in 1873, when it was not being used. There are, on the property, 14 miners' houses, agent's and captain's houses, and other buildings, also boiler, engine, and hoisting apparatus at No. 2 shaft. A small stream supplies the water for the stamp mill in limited quantity. An excellent highway runs through the location, extending to Houghton and to Ontonagon, which latter place is 15 miles away. The village of Maple Grove is three miles distant. The highway now being constructed from L'Anse to terminate here, intersects the Houghton & Ontonagon road in the Bohemian location. L'Anse is distant, east, 36 miles. If the mineral veins are sufficiently rich to repay the cost of working, it would seem that this mine could be again got to work with comparatively little expense. A great deal has been already done. The mine has been more or less worked by tributers for years. The property is still owned in Philadelphia, and is now advertised for sale by E. M. Davis and J. G. Henszey, Philadelphia, Pa. A. Meads, Agent, Ontonagon, Mich.

THE GREAT WESTERN MINING COMPANY.

This company was another of the offsprings of the Pittsburg and Boston, organized in 1863, the location comprising the S. E. $\frac{1}{4}$ Sec. 30, and S. W. $\frac{1}{4}$ Sec. 29, T. 51, R. 27, adjoining the Bohemian on the north. Some copper had been previously obtained from the Indian pits along the mineral out-croppings on the property. A few tons were shipped in 1865. The work was begun in 1863. The veins are so capped over and irregular that the explorations failed to discover anything of value. The property is in charge of Captain Chynoweth, of Greenland, and is owned by Dr. Hussey et al., Pittsburg, Pa.

THE CHIPPEWA MINING COMPANY.

The Chippewa Mining Company held the quarter section north of the Great Western, to wit: The N. E. $\frac{1}{4}$ Sec. 30, T. 51, R. 37. No work of any consequence was ever done.

The Algomah Mining Company worked the location next to the west—the W. $\frac{1}{2}$ Sec. 30, T. 51, R. 37,—in 1852 and thereafter.

THE TOLTEC CONSOLIDATED.

The location of this once important mine lies next west from the Algomah and north of the Hilton, comprising the S. $\frac{1}{2}$ Sec. 25, T. 51, R. 38. The company was organized in 1850, and began work in March, 1851, by clearing some land and erecting a few houses, and in July thereafter mining work was begun.

In 1854 there had been 1,000 feet of shafts sunk, and 1,700 feet of drifting. The copper that was obtained consisted of isolated masses, sometimes of considerable size, one being found at a depth from the surface, in 1855, of 130 feet, weighing 23,300 pounds. But these masses, however gratifying, were of too infrequent occurrence to compensate for the cost in obtaining them, and after working about 10 years, and making an outlay of half a million of dollars, the company was obliged to suspend operations altogether.

Amount of copper shipped from the mine in 1853 was 10,380 pounds; in 1854, 20,000 pounds; in 1855, 163,669 pounds. A stamp mill with eight heads was built. It was expected that the water pumped from the mine would contribute largely towards supplying it, but the calculation failed to be borne out by the subsequently experienced fact.

The agent of this mine made large expenditures in surface improvements, with the expectation that the mine would give a large yield; his anticipations were not realized. There was too much money engrossed on the start in surface improvement, in clearing land and destroying timber that should have been saved for the subsequent use of the mine, raising smiling fields of grain and vegetables, building up a handsome and pleasant village, and generally adorning and improving the landscape, seems to have occupied the attention of the agent, to the neglect of legitimate mining work. These expenditures may, many of them, be well enough when the results of the mine bear them out and sustain them. But until the mine has succeeded in paying, and the fact is demonstrated beyond a doubt that the yield of the mine will be adequate to the great outlay, such improvements are premature and extravagant, and in case of failure of the mine to produce the anticipated result, are a wholly unnecessary and a total loss to the company, possessing, generally, little or no value. In this manner $100,000 were expended almost wholly in advance of actual need. A stamp mill was built at a cost of upwards of $20,000, in advance of the production of any considerable amount of stamp rock necessitating its use; $12,000 were expended in a plank road to Ontonagon before the company were fully aware whether their business would necessitate a great amount of transportation.

It is true, that at an early day, very many of those who had the management of mines were over certain of ultimate success. They were sanguine of holding another Minesota, and before proceeding to determine the productive capacity of their lodes they began with a far too liberal surface outlay, and expected that rapid results were sure to follow. Dear bought experience has taught these men the importance of, as far as possible, proving the true wealth of a vein before the expenditure of large sums of money can be justified. A mining enterprise that has only the showing of a large surface improvement, however magnificent the scale, may offer a poor investment.

The Toltec began in 1850, and in 1855 consolidated with the Farm Mining Company. In an early day the stock was quoted well in the stock market—$18 to $20 per share. An assessment was made on February 9, 1880, of fifty cents per share, for the purpose of securing funds to pay off indebtedness, etc.

Office of the company, Boston, Mass.; Joseph Vila, Secretary and Treasurer.

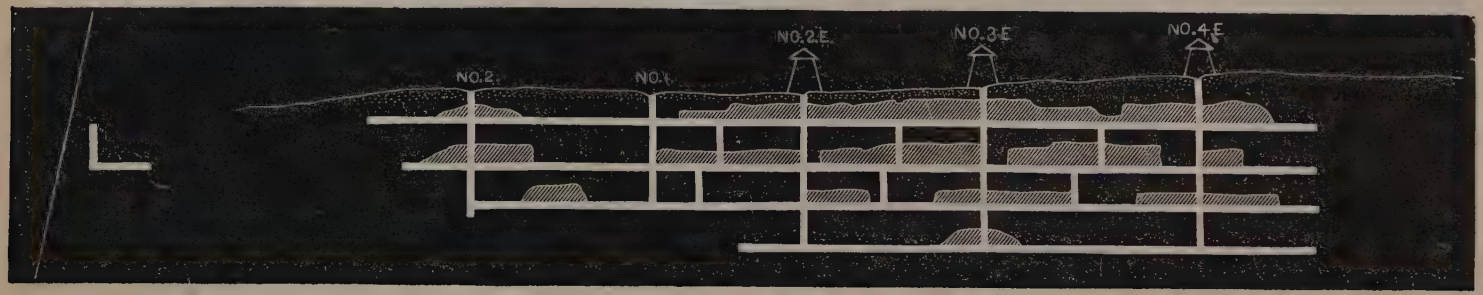
INDIANA MINING COMPANY.

The location of this company was Sec. 21, T. 51, R. 37, organized in 1862, and expended about $200,000. Two shafts were sunk to the third level, a number of houses were built, a hoisting engine erected, a stamp mill erected,

LONGITUDINAL SECTION OF THE TOLTEC MINE,

ONTONAGON COUNTY, MICH.

Scale, 300 ft. to one inch.



etc. The company worked for three years and then suspended operation; the stamp mill was sold to the Petherick Company.

Office of the company in New York; Jas. M. Mills, Secretary and Treasurer.

FIRE STEEL MINING COMPANY.

Adjoining the Indiana on the east, the N. W. ¼ Sec. 22, T. 51, R. 37, is the location of the Fire Steel Mining Company, which, in an early day, did some mining work, but operations were suspended in 1855, and the machinery and tools removed to the Douglass Houghton mine.

THE DOUGLASS HOUGHTON MINING COMPANY.

This mining property consists of Sec. 15, except the S. W. ¼, T. 51, R. 37. Here, also, some mining work was done in 1854, 1855, and 1856, but with results that bore too small a ratio of profits to the expenses, and in 1858 work was discontinued. The location was afterward known as the Henwood. In 1853 a stamp mill with eight heads was erected, run by water power. A shipment of five tons of mineral was made in 1853, and 25 tons in 1854.

THE ALGONQUIN MINING COMPANY,

now called the Pennsylvania, owned Sec. 2, T. 51, R. 37, and the W. ½ Sec. 36 and E. ½ Sec. 35, T. 52, R. 37. Work began here in 1848, and was continued more or less for a number of years. The surface work included a road 11 miles long, to a landing on the Fire Steel river, two miles from its mouth, where a warehouse was built, etc.

THE COPPER MINING COMPANY.

Location comprising 320 acres on Secs. 20 and 21, T. 52, R. 36, northeast from the Pennsylvania mine. The company was started in 1864; but little work was done.

WINONA MINING CONPANY.

Organized in 1864 under the auspices of the Hon. J. A. Hubbel. The company opened a mine on the N. W. ¼ Sec. 29, T. 52, R. 36. The veins were very clearly defined by the ancient pits, which showed that the early miners had worked these out-crops pretty extensively. The company put a force of miners to work in 1864, and a few barrels of copper were got out and shipped; not much work, however, was done. In 1870 the mine was let to tributers.

The company still preserves its organization and holds the property.

STONINGTON MINING COMPANY.

Five or six miles still further northeast on the range, and eight or nine miles southwest from Carver bay, are a number of early mining locations, of which the most southerly was the Shawmut Mining Company—the E. ½ Sec. 10, T. 52, R. 36. A small amount of copper was got out in 1856. An adit was driven in the vein, but the lode proved hard and poor.

THE FRANKLIN MINING COMPANY.

Location the N. ½ Sec. 2, T. 52, R. 36. A road was cut out to the mouth of Misery river on Carver bay, from the mining location, and a village plat laid out. But little ever came of it.

WEST MINESOTA MINING COMPANY.

Northeast ¼ Sec. 19. Some money was spent here in 1854, to find the Minesota and the National veins, but nothing valuable was found.

THE ONEIDA LOCATION.

South ½ Sec. 19; south of the West Minesota. Exploring was also done here in 1854, etc., to find the Minesota veins.

FOREST MINING COMPANY.

Comprising the S. E. ¼ Sec. 25, T. 51, R. 40, and N. E. ¼ and S. W. ¼ of Sec. 30, T. 50, R. 39, was owned by the same parties who held the Toltec. The location lies two miles west of the Ontonagon river. It was first known as the Cushin location, and was worked in 1849, a mass having been previously found which weighed 1,860 pounds, was found in an old Indian pit, and subsequently a number of masses were found in clearing out these old workings. Several tons of copper were thus obtained near the surface. The company was organized in 1850, under a special charter from the State of Michigan, and work was begun under the direction of Mr. W. H. Stevens, on Sec. 31, which was afterwards set off as the Glen mine. But work was transferred to Sec. 30 to the vein revealed by the line of ancient pits. Ten miners were set to work on this vein, and a shaft 160 feet in depth was sunk and intersected by an adit. In doing this work five tons of copper were obtained, and some stamp rock. After the first year the mining force was increased to 30 men, and a stamp mill with eight heads of stamp was built, a number of miners' houses and other dwellings and buildings were erected, and about 100 acres of land were got under cultivation. The directors were imbued with a good deal of faith respecting the value of the property. They thought that they had the same veins worked on the Minesota and National. The Forest organized a number of mining companies; the Glen, in 1852, comprising the S. ½ of the S. E. ¼ and the S. W. ¼ Sec. 31, T. 50, R. 39; and also in the same year was set off the E. ½ Sec. 36, and given to a new company called the Shirley Copper Company. Also was formed the Tremont, and the company set off to it the S. E. ¼ Sec. 26, and the N. E. ¼ Sec. 35.

The Devon Mining Company was formed in the same way, and had allotted to it the S. W. ¼ Sec. 25, and the N. W. ¼ Sec. 36, T. 50, R. 39.

After these successive depletions the Forest Company still retained upwards of 1,000 acres of land. The product of the mine in 1853 was 42 tons. In the spring of that year a freshet, which raised the waters of the Ontonagon river 22 feet, swept away much of the company's property.

In 1856 a fire destroyed the stamp mill and other surface property. The product that year was 175 tons. But in 1854 and 1855 no copper was shipped. Up to 1858 $100,000 were expended in assessments. In that year the company was re-organized under the general mining laws of the State, as the Victoria, and assessments were afterwards made of $4 per share.

A good deal of work was done at the Forest location, and much money spent, but it all resulted in disappointment. The location possesses an ample water power, and it is thought that the lode in which the principal mine was opened would afford considerable stamp rock.

The property is now offered for sale. Alfred Meads, Agent, Ontonagon, Mich.

THE UNITED STATES MINING COMPANY

originated in 1852 and built a few houses, and did a small amount of work on Sec. 34, T. 51, R. 40.

THE CORTEZ MINING COMPANY

organized the same year, and did about the same amount of work as the above.

ATLANTIC MINING COMPANY

made a small beginning on the S. W. ¼ Sec. 34, T. 51, R. 38.

THE NORWICH MINING COMPANY.

One of the most important of the mines that were worked west of the Ontonagon river is the Norwich. This, and the Windsor, the Victoria, and the Nonesuch are the only ones at which any considerable amount of work has been done.

Mining work began here in 1850. The company owned 640 acres of land, and at that time it was very difficult to get supplies to the mine; at first the supplies had to be packed 12 miles on the backs of men. The out-crop of the vein is on the exposed side of the bluff, which afforded convenient opportunity for driving an adit to intersect the vein. The bluff is of trap rock, running nearly east and west, and presents a precipitious face to the south, but a more even one to the north. The out-crop of the main vein is at an elevation of 250 feet above the base of the bluff, and runs east and west, parallel with the formation, dipping to the north into the bluff. To the south the land is rolling, having a gradual descent to the southeast, timbered originally with pine, hemlock, maple, etc., and well adapted, as is evinced by what is now under cultivation, to the production of a variety of agricultural products. To the south of the bluff, about 100 rods, is the north fork of the Ontonagon river.

At the time of commencing operations a good deal of work was done in clearing land, building some houses and getting a road made to the location, so that for the first few years but little mining work was done. However, five tons of copper were got out in 1852, which was increased to 18 tons in 1853, and to 25 tons in 1854. Work progressed with moderate results for six or eight years thereafter. A stamp mill was put up, a portable saw mill, a hoisting engine, pumping engines, etc., an agent's house, office, warehouse, shops, boarding house, and 10 miners' houses were built. A railroad track from the mine to the stamp mill, a distance of 1,000 feet. was laid.

The results of the work of the stamps were about the same as at other mines, but the remoteness of the locality, rendering transportation extremely difficult and expensive, combined with the financial embarrassments of the company, caused a cessation of work in 1858,—up to that date amounted to about 500 tons.

The hoisting engine was placed 145 feet below the mouth of the adit, and the hoisting ropes run up on pulley stands, and thence for 100 feet in the adit and down the shaft. The arrangement worked well. The engine was a 12-inch cylinder, 2-foot stroke. Some work on tribute was continued until 1863, when the company re-organized and consolidated with the Windsor, when work was begun under the superintendence of C. E. Roberts. The mine, having been worked on tribute, was in bad condition, and general dilapidation prevailed.

But the mine was cleaned, the machinery and buildings repaired, and mining resumed and continued for two years, when the company shut down permanently, having expended $230,000 of its capital stock. For some time the location was occupied by squatters, who derived a profit from the improved lands. The property comprised 320 acres in Secs. 11 and 12, T. 49, R, 41. Adjoining the latter is the Windsor, which was worked quite extensively at the same period, and was finally consolidated with the Norwich. A stamp mill with eight heads was built in 1856; Sec. 12, T. 49, R. 41.

OHIO TRAP ROCK MINING COMPANY

was one of the oldest mining companies in Ontonagon county. The location adjoins the Norwich. It was formed under a special charter granted by the State in 1849. The stock was divided into 6,000 shares, of $25 each. The company held 2,000 acres of land. The property was first held under a permit from the War Department, and was explored in 1846, and in 1847 Capt. W. H. Stevens took charge of the mine, and for two years thereafter worked 10 or 12 miners in drifting an adit and in sinking two shafts. In 1852 the operations of the company were considerably enlarged. A stamp mill with 24 heads of stamps was built, and other improvements made.

The company originally entered 3,316 acres of land, and subsequently sold 1,614 acres to the Colling Mining Company, leaving 2,002 acres, embracing one and three-fourths miles across the range. A church was built, 120 acres of land put under cultivation, etc.; but very little copper was obtained. Work suspended in 1857. The capital stock—$150,000, was all exhausted in 1855, and the company was reorganized under the general mining laws, with a capital stock of $300,000. No work has been done since 1857.

THE HUDSON MINE,

situated 80 rods from the Norwich; shafts were sunk on two veins, 60 feet, and 75 feet, respectively, in depth, and 36 feet of drifting done. Two houses were built, some clearing done, etc., but work suspended in 1856, and has not since been resumed.

THE PITTSBURG MINING COMPANY,

holding 480 acres of land, and situated three-fourths of a mile from the Norwich, also did some work in 1852, 1853, 1854, and 1855; about 18 acres of land were cleared, two dwellings, store house, shop, barn, etc., were built, and some mining work was done on these veins. On the first a shaft was sunk 60 feet; on the second, 80 feet; and a cross-cut of 40 feet was run south from the bottom of the latter. On the third vein a shaft was sunk 15 feet. No work has been done since 1856.

CLIFTON MINING COMPANY.

S. W. $\frac{1}{4}$ Sec. 10, N. E. $\frac{1}{4}$ and S. W. $\frac{1}{4}$ Sec. 15, T. 49, R. 41, situated one and three-fourths miles west from the Norwich. Work was begun on the location in 1852, and continued till 1855. There were some surface improvements made, and the mining consisted of an adit 300 feet long, across the bluff, and two shafts, 123 feet, and 263 feet, respectively, in depth. The location has since been abandoned.

THE SHARON MINING

location adjoins the Clifton, and the operations were carried on at the same time. Two shafts were sunk—80 feet, and 110 feet, respectively in depth; drifted 160 feet; S. E. ¼ Sec. 9, T. 49, R. 41.

THE CASCADE

adjoins the latter location, and possesses the advantage of an abundant water power. A small amount of mining work was done.

THE CLINTON

location adjoins the Cascade on the west, and comprises 320 acres. Here one shaft was sunk, a house or two was built, etc., in 1853–4. Nothing has since been done.

THE DERBY

adjoins the latter, and is four and one-half miles from the Norwich. Here work was begun in 1852 and continued for three years. Two shafts were sunk, 60 feet and 80 feet in depth, respectively, and 250 feet of drifting done in the vein. A number of buildings were erected, and 1,200 pounds of copper got out. S. W. ¼ Sec. 19, T. 49, R. 41.

These mines,—the Norwich, Windsor, Derby, and Sharon,—were owned by one corporation, incorporated under the laws of Vermont in 1849, with office at Windsor, in that State, called the American Mining Company.

THE EUREKA MINING COMPANY

was organized in 1863, and held what was previously known as the Conklin preëmption or Muryweather mine, situated at a short distance to the northwest from the Norwich, being the W. ½ Sec. 2, T. 49, R. 41. Some mining work had been previously done on the location, and about five or six tons of copper shipped. Several houses had been built, and some other necessary buildings; but the Eureka Company did not do much work.

THE FOREST SHEPARD MINING COMPANY

organized in 1864, and held 2,366 acres of land near Lake Agogebic, and did some exploring at that time; subsequently in 1874 some Marquette men sent an exploring party onto the location, which worked for a while on an outcrop of mineral, but it did not appear to be valuable.

THE HARTFORD MINING COMPANY,

owning 320 acres of land on Secs. 32 and 33, T. 50, R. 40, two miles west from the Victoria. The company was organized in 1864. A small amount of copper was raised—about three tons.

THE GOGEBIC MINING COMPANY.

S. W. ¼ Sec. 26, T. 49, R. 42, organized under the general mining laws of the State in 1853. A few thousand dollars were expended on the location, and considerable effort was made to sell the stock.

THE WAUKULLA.

Four hundred and eighty acres in Secs. 19 and 20, T. 49, R. 42. A small amount of work is being done from year to year in driving an adit across the formation, from the side of the bluff facing Lake Gogebic. The mistake seems to be in not selecting a cross course in which to drive the adit, instead of penetrating in the hard trap rock.

THE CARP LAKE MINING COMPANY

was organized in Cleveland, Ohio, in 1858, under the mining laws of Michigan. The company held 1,087 acres of land, but mining work was instituted on Sec. 15, T. 51, R. 43. Two shafts were sunk, and three and one-half tons of refined copper shipped in 1860. The copper occurs in fine particles, disseminated in a belt of altered sandstone. When exposed to the weather, and partially decomposed, the copper assumes the form of a red oxide of various degrees of richness. The shafts were sunk in this vein at several points, developing the continuity of the deposit, which has a northerly dip under the lake. The mine is located on the north side of the hook or curve which the range makes, when it reaches the Porcupine Mountains, the Nonesuch mine being on the south side of the main extension of the range, before it begins to turn to the north. At the Nonesuch the rocks dip to the south, presenting a similar character, as at the Carp Lake. This belt of altered sandstone is about 500 feet in thickness, and is underlaid by a belt of amygdaloid trap. Two adits were driven in the bluff, from the south side, above Carp lake, to the distance, respectively, of 250 feet and 40 feet, some land cleared, a few log houses built, and the machinery for a stamp mill procured, when the company, in 1862, suspended operations. Recently some exploration has been made on the property by Mr. Alfred Meads, of Ontonagon, and an effort is being made by him to revive an interest in the locality, sufficient to cause the resumption of mining work.

THE MUSCOWAUBIC MINING COMPANY

organized in 1859, by Cleveland parties, adjoining the Carp Lake mine. The company did a small amount of work. The company held 1,000 acres of land in T. 51, R. 43.

There were several other locations in this vicinity, formed by Cleveland parties, and a few thousand dollars were expended on each. Among them are the Lone Rock, The Cuyahoga, and the

PORCUPINE MOUNTAIN MINING COMPANY.

organized under the general mining laws of the State, in 1860. The property comprised 480 acres of land, consisting of the E. ½ and S. W. ¼ Sec. 28, T. 51, R. 43, contiguous to the Carp Lake and Muscowaubic mines. The Porcupine Mountains here attain an elevation of about 1,000 feet, and Carp lake, in the vicinity of which these mining locations are situated, lies in a deep gorge about two miles south from Lake Superior, at the base of a precipice 500 feet in height, sheltered and hemmed in by the surrounding mountains. Its elevation above Lake Superior is 483 feet, and its length is a little upwards of a mile. Into the east end empties the river of the same name, which also flows out from its western extremity, in a southwesterly direction, following the base of

the mountain range which, for a distance of five miles, presents a southerly wall of rock several hundred feet in height, occasionally broken through by transverse gorges.

At the western base of the mountains the river turns to the north and mingles with the waters of Lake Superior. On the south there are several small streams which empty into Carp lake. Still further to the south is a more elevated range of quartz and jaspery rocks. Beyond these stretches, for many miles, are apparantly level, forest-covered plains.

The company sunk exploration shafts, and built a few log houses, but did little else. If the deposits here ever prove to be worth working, the locations are admirably situated for doing so cheaply.

THE CAMBRIAN MINING COMPANY

was organized under the general mining laws of the State in 1854, owning the S. W. ¼ Sec. 24, T. 48, R. 49, situated on the north shore of the Montreal river. The company did no mining work.

THE NONESUCH MINING COMPANY.

In the winter of 1865-66 a half-breed by the name of Frank Cadotte discovered, in the bed of the Little Iron river, near the base of the Porcupine Mountains, on the line between Secs. 1 and 12, T. 50 N., R. 43 W., a belt of argillaceous, conglomeritic sand rock, densely impregnated with fine granules and scales of copper. On making known his discovery to gentlemen in Ontonagon, the land, comprising the south half of section 1 and the north half of section 12, was immediately purchased from the government, and a further examination of the property instituted. The occurring series of the formation with which this copper-bearing bed is associated are plainly exposed in the bottom of the stream and in the ledges upon either side of the deep channel, which has been formed by the denuding action of the water. The strike and dip are readily obtained, and indicate the direction of the formation to be N. 49½° E., and having a southeasterly dip of 30° with the horizon. The width of the conglomeritic copper bed is about seven feet, measured at right angles with the dip, and it occurs between a wide bed of blue colored, slaty rock, which overlies it, and a narrow bed of sand rock, which forms the underlay.

The results of the explorations made by the parties owning the property were apparently so favorable that the organization of a company to open a mine was decided upon, and the exceedingly appropriate name of Nonesuch was selected as the title of the company.

The organization was made in 1867, and the parties thereto—residents of Ontonagon county—were W. Willard, L. M. Dickens, D. S. Cash, W. W. Spaulding, L. C. Patterson, John Willson, Wm. Van Schichk, F. W. Anthony, F. G. White, and James Mercer, the latter gentleman being continuously, while the office remained at Ontonagon, the company's secretary.

Work was immediately begun, and continued off and on for several years, as assessments could be got in to pay the expenses. It was all dead work; to open the mine and bring it to a paying point required more capital than the stockholders felt able to advance. None of those interested questioned the fact of the lode carrying copper in paying quantity, but the important problem was to find out how to make it available—to save it. The mine was opened by two shafts sunk in the lode at a distance of 250 feet apart, and upon either side of

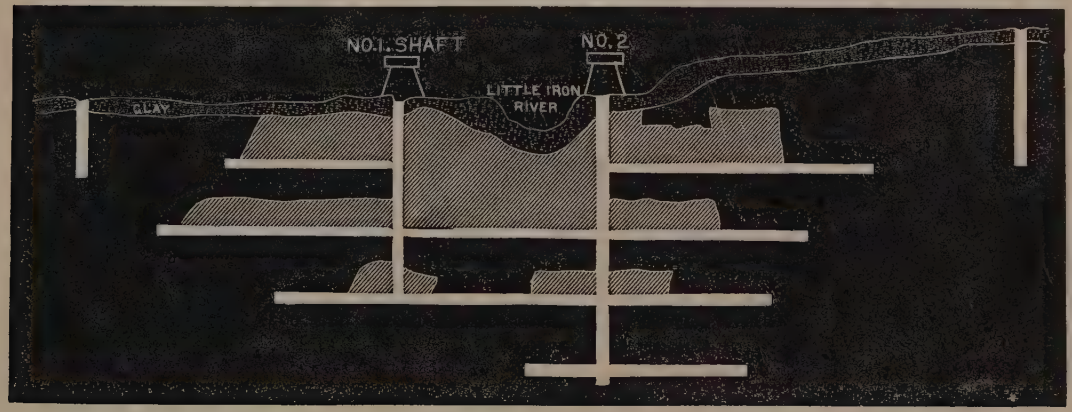
the river, and carried down, by the original company, to the second level. A dam was thrown across the stream at a short distance above the mine, to furnish the power and water necessary for a small stamp mill, which was built at some distance below, and provided with a 20-inch turbine wheel, run by the water conducted to it from the dam. The results with the stamp mill were unfavorable; they did not, by their manipulations, succeed in saving but a small percentage of the copper; the particles of copper proved to be so fine and thin that they floated away, and were lost in the tailings. Attempts were made to determine the feasibility of smelting the rock. A preliminary trial for the purpose, at the smelting works at Ontonagon, was attended with encouraging results, but subsequently a few tons sent to Detroit gave, as reported, a low percentage of copper.

After the panic of 1873 the affairs of the company had become somewhat involved; the stockholders did not feel willing to pay further assessments—$2 per share had been thus far paid in—and the expedient was resorted to of watering the stock for the purpose of raising further funds; so that in October, 1875, at a meeting of the stockholders, it was determined to increase the capital stock to $1,000,000, to be divided into 40,000 shares, thus giving 20,000 shares to be sold, and the avails to be used in the interests of the company in the prosecution of mining work. These extra shares were bought by Messrs. J. H. and R. P. Wade, of Cleveland, and these gentlemen thus obtaining a controlling interest in the concern, removed the office of the company to that city. Mr. R. P. Wade was already largely interested in the Porcupine Mountain district, and was previously a stockholder in the mine, and after the purchase of the surplus stock he himself was chosen President, and Mr. J. H. Wade, his son, became Secretary and Treasurer. The sum realized by the sale of the stock was $60,000, and unfortunately for the original management, they split upon the very rock which they had sought to avoid. Soon after the removal of the office from Ontonagon to Cleveland, an assessment of $1 per share was made; this, most of the old stockholders failed to pay, and the forfeited stock was bought in by the Messrs. Wade, who soon became the sole possessors of the property. Immediately after obtaining control of the affairs of the company in 1875, Mr. Wade caused the work at the mine to be renewed with increased vigor. No. 2 shaft was sunk to the fourth level, and No. 3 shaft—the southerly one—to the third level. These shafts were connected at the different levels, and the drifting extended in the first level 250 feet to the north of No. 2, and 214 feet south from No. 1, and in the second and third levels a corresponding amount; in the fourth level about 150 feet of drifting was done. Two other shafts were begun—one, 500 feet to the north of No. 2, and the other 400 feet south of No. 1. These shafts are down to the first level. To the stamp mill was added a 25-horse power engine, the turbine not proving a sufficient power. The road to Ontonagon was improved, and a wagon road to the lake was begun. The product in 1874 was about 14 tons of ingot, and in 1875, 25 tons. The mining expenses for 1875 were $52,000. In 1876 the president, Mr. Wade, died, and work at the mine was discontinued. The stamp mill was soon after destroyed by fire.

The mine remained idle until two years ago, when Capt. Thomas Hooper, who had been the company's agent in previous years, and was entirely familiar with the location and with the peculiarities of the lode, obtained a lease of the mine for a term of seven years, he giving to the owners 25 per cent of the product. As soon after the necessary funds could be raised, and the materials got to-

LONGITUDINAL SECTION OF THE NONE-SUCH MINE.

Scale, 200 ft. to one inch.



gether, Captain Hooper began the work of preparation for mining. He built a stamp mill, east from No. 2 shaft, down by the water against the north bank of the river, the machinery of which is run by a 30-foot overshot wheel, 8-foot breast, the water being conducted to it from the dam along an open race 700 feet in length. During all the year, except in season of low water, this power is sufficient for the purposes of the mill. But to supply such seasons of emergency, Captain Hooper has, during the past year, got into position the old engine, ready to supply the necessary power when the water fails. The stamp mill is warm and well lighted, and the wheel is sufficiently well enclosed to be free from ice. At the present time the hoisting is done in No. 1 shaft, but both No. 1 and No. 2 are furnished with skip ways and horse whims, the rock being dumped from the skip cars onto the floor of the shaft house, where it is sorted and thence trammed 100 feet across the river on a horizontal track to the stamps. The breaking is done with hard sledges, a not very difficult matter, as the rock is easily fractured. The hoisting is done with a horse whim, raising at present time 24 tons of rock per day, of which 16 tons are taken to the stamp mill, and 8 tons rejected. There are 4 heads—16 stamps—and Captain Hooper intends to add another head—4 stamps—the coming summer.

The average force employed is 15 men, of whom 6 are miners and 5 in the stamp mill. The cost for tramming, breaking, stamping, washing, etc., per ton of rock is about $1, and the amount of mineral saved by the process employed is 3 per cent cleaned to 62 per cent ingot. Unless the mining force is considerably increased, together with added facilities for stamping and washing, there is ground enough already open for some years to come. The average cost for stoping is $10 to $11 per cubic fathom; the cost of sinking shafts is $10 per foot, and for drifting in levels, $5 per foot.

There is some talk of buying the Union stamp mill, and of moving it to the mine, and thereby securing facilities for stamping, it is estimated, 100 tons of rock per day.

The washing apparatus is largely an arrangement of Captain Hooper's own devising; the water from under the stamps holding the powdered rock in suspension is distributed through a series of 20 small pits uniformly onto the surface of an oil cloth which lies upon rollers, and inclines upwards towards the stamps. These cloths, of which there are two, are each 20 feet in length and 5 feet in breadth, and are carried slowly upward by the revolution of the rollers on which they rest, against the water which flows downward over the surface. Thus a portion of the particles of copper, having a greater specific gravity than the particles of rock, adhere to the cloth, and are carried upward and over the upper edge of the apron, and are dropped upon the floor beneath as the cloth passes around on the under side. The tailing from the aprons is treated through a system of screens and jigs, and finally in hand buddles.

The plan for washing this rock has not attained to perfection yet, but some parties are now upon the ground preparing to treat it according to a method which they are not prepared to disclose, but which the person, Mr. Jenks, having the matter in hand, claims will cheaply and effectively save the copper contained. Owing to the early close of navigation before all the materials were got on the ground, these gentlemen have been delayed in perfecting the arrangements for giving their theories a practical test. An option for the purchase of the mine and of the lease, in case of success, has been secured.

The mine makes but very little water, and the walls are firm and well

defined; the lode has a uniform width of seven feet, and the copper is distributed through the bed with great uniformity. A cross section of the lode shows the copper in seams or bands, which run and dip with the formation, the alternating streaks being uniformly distributed across the lode. No mass copper occurs, but a small percentage of barrel-work is obtained, chiefly ribbons and leaf copper from the surfaces of contact, and in the seams of the hanging wall. Both the slate and foot wall carry copper, but in less quantity than the conglomerate.

The elevation of the mine above Lake Superior is about 400 feet, and the distance therefrom about five miles. They are connected by a good wagon road, and by a tram road nearly completed. At the lake a dock has been built in 16 feet of water, at which boats may land the supplies and take aboard the product. A good highway connects the mine with Ontonagon village, from which it is distant, in a southwesterly direction, about 22 miles. This highway has been recently greatly improved by the construction of substantial bridges across the streams which lie in the route.

The surface improvements on the location comprise about a dozen good log dwelling houses, office, store house, and some other necessary buildings, and about 50 acres of cleared land, which affords sufficient hay for the teams and other stock. The land surrounding the location is dry, hard-wood land, with a soil of excellent quality, as is evident from the character of the timber and other indications which may be observed.

The product of the mine for the portion of the year worked in 1879, was 16 tons of ingot copper, and for ten months of 1880, 58 tons of mineral, yielding 62 per cent = 36 tons refined copper. The product for the months of October and November last was 10 tons each month.

Captain Hooper is now fairly under way, and is making money with a force of only six miners. He has done very much of the preliminary work himself, and is now his own superintendent and clerk. If he continues to work the mine it is his intention, as previously stated, to enlarge his stamping and washing facilities, and to increase, in a corresponding degree, his mining force. He has demonstrated his ability to successfully work the mine, and is nearly certain of reaping a reasonable profit during the remaining term of his lease. The accompanying longitudinal section will show the underground workings of the mine.

KAOLITE.

A valuable deposit of this mineral occurs in a bluff in the east bank of the Ontonagon river, near the old Minesota landing. A vessel load is got out each winter, and hauled to Ontonagon, and in the summer a vessel is sent up, which takes it to its destination. It is now owned by parties in Akron, Ohio. The kaolite is dug from the bed in which it exists, from high up the steep bluff, and slid down a shute to the bank of the river, where it is loaded into sleighs which haul it down the ice to the harbor, where it is barreled and got ready for shipping. The mineral is said to be of a superior quality, excellent for polish, and for the manufacture of fine earthen ware. The deposit seems to be an extensive one, and possibly the mining of it may grow into greatly increased importance.

In 1875 a company was formed in Marquette to work the deposit, but they soon after sold out to W. Robinson & Co., of Akron, Ohio.

PORTAGE LAKE MINES.

The Portage Lake, Houghton County, mines possess many advantages. Aside from the regularity and the ascertained richness of the important copper-bearing lodes which are found in this county, nature has otherwise greatly favored the region, affording it natural advantages for conducting mining enterprise that are unsurpassed.

Chief among these natural advantages is the broad, deep water channel, which, with the canal that has been cut at its western extremity, extends entirely across the base of the Keweenaw peninsula, really constituting the peninsula an island. By the successive improvements which have been made, this channel suffices for the passage of the largest vessels, affording to the mines of this district the finest facilities for shipping, and to most of them an abundant supply of water for stamping and washing their rock.

Previous to 1860 the freight was discharged at Portage entry, and conveyed thence to Houghton and Hancock in flat-boats towed by a small steam barge. The mining companies, organized to work in the vicinity of Portage lake, early foresaw the necessity of improving the channel from the entry to the lake, sufficient for the admission of the largest vessels. This important work was undertaken in 1859 by the Portage River Improvement Company, an organization made for that purpose, to the stock of which the mining companies immediately interested principally contributed. The work was performed by Messrs. Barton & Williams, of Buffalo, N. Y., under contract with the company. These gentlemen had but recently been government contractors for the improvement of the St. Clair flats.

The following season (1860) 115 steamers and 17 sailing vessels entered the port and discharged their freight and passengers at the Houghton docks. Another important enterprise was added to the mining interests of this locality in 1860, by the erection of the smelting works there. The first regular smelting, 12,000 pounds of mineral from the Huron mine, was done before the close of that year with such satisfactory results, that thenceforward the reputation and business of the establishment was assured.

These works enable the mining companies in the vicinity to have their mineral, produced after the close of navigation, reduced and transported to the eastern markets during the winter, and thus derive a possible advantage of an increased price. Or if they do not wish to transport it by rail, which may be done by hauling in sleighs to L'Anse, the terminus of the railroad, they can have it smelted and in readiness for shipment on the opening of navigation in the spring.

The Portage Lake foundry and machine works were also started in 1860, and became at once an important adjunct to mining business. Up to that time the mining companies were obliged to procure their castings and machinery from Detroit, and in case of breakage, particularly in winter season, long and expensive delays frequently occurred. Some of the mining companies contributed to aid the enterprise at the outset, and it started sufficiently equipped to meet the requirements of its business in a satisfactory manner. An extensive sash, door, and blind, etc., factory was also established at the same period, and contributed greatly to the facilities of building, supplying a want that had been seriously felt.

The important villages of Houghton and Hancock, situated nearly opposite to each other, upon the margin of Portage lake—the former upon the south side, and the latter upon the north—owe their origin to the inauguration of

mining enterprise in the vicinity, and have grown in wealth and importance with the development of the mines. But while naturally dependent upon the prosperity of mining industry for their business and support, they have become something more than merely so called mining towns, and in the elegant and costly private residences and public buildings with which they are adorned, give evidence of the refinement and permanency, which pertain to the large and prosperous villages of our State.

The towns are connected by a bridge, with a draw for the passage of vessels, and along the margin of the lake upon the north side are situated the great stamp mills of the Osceola, Hancock, Quincy, Pewabic, and Franklin Companies, the planing mill, the smelting works, etc. The Hancock, Quincy, Pewabic, and Franklin mines are situated upon the high bluff to the north, and long, gravity-inclined railroads connect the several stamp mills with the top of the bluff, and thence by corresponding tracks to the mines. The Mineral Range railroad, three-foot gauge, extends from Hancock to Calumet, a distance, northerly, of 13 miles. This is the only independent railroad organization operating a line of road, existing in the copper region.

The continuous pounding of the stamps, the hum of the planes, the scream of the little locomotives on the railroad, the ceaseless rattle of the cars up and down the inclines, and, in the season of navigation, the hoarse sound of the whistle of the large steamers which frequently arrive at the docks, and pass on east or west into the great lake, afford evidence of busy activity. Added to this are the lake and the hills which bound it upon either side, making a picture of natural scenery altogether pleasant, and not easily found elsewhere.

While Hancock has the largest amount of business of the two towns, Houghton yet possesses advantages that make it the most generally resorted to by the traveling public, and the most esteemed as a place of residence. To the south of Houghton are the Sheldon and Columbian, Portage, Isle Royal, Huron, and Atlantic mines.

THE ISLE ROYAL MINING COMPANY.

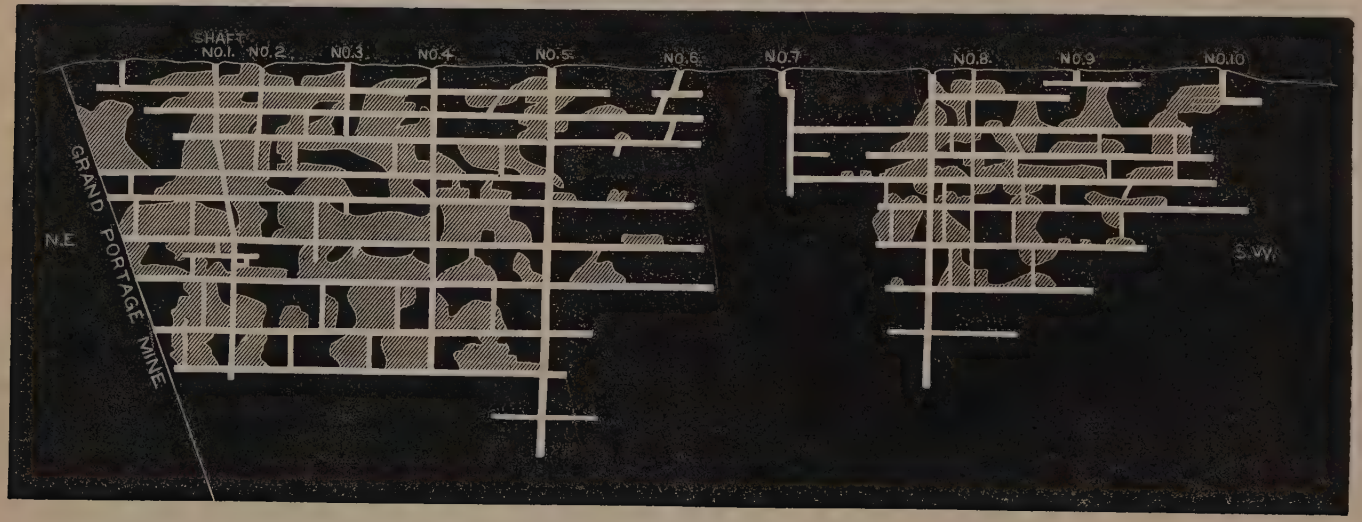
This company enjoys the distinction of being the pioneer mining company on Portage lake. It began work in August, 1852, on the N. W. ¼ of Sec. 1, T. 54 N., R. 34 W., but owning in addition another body of lands, which made its total estate 501.5 acres. The company had been incorporated to mine on Isle Royal, where it was engaged for several years prior to the commencement of operations in the vicinity of Portage lake, but met with no success there. Upon their new location they discovered the existence of three veins about 200 feet apart, and on the middle one of these the mining work was first begun, and this lode has thence been called the Isle Royal. Its selection was determined by the number of Indian diggings, which extended along its outcrop across the greater section. These, when explored, developed a good show of copper; the vein proved to be large and with good walls, running and dipping with the formation, the bearing being N. about 62° E., and the dip about 60°. The bed proved to be even and well defined, with inclosing rock of gray trap.

In 1854 the works had extended along the vein 1,600 feet, and the total sinking aggregated 600 feet, the drifting 1,000 feet, and the amount of copper taken out, mostly barrel-work, was, in 1853, 31,773 pounds, yielding 62 per cent = 18,738 pounds ingot; in 1854, 57,044 pounds, yielding 39,935 pounds ingot copper.

On abandoning Isle Royal the company had conveyed its portable mining

LONGITUDINAL SECTION OF THE ISLE ROYAL MINE.

Scale, 300 ft. to one inch.



plant to the new location; the principal article brought over was a small portable engine, which, when required, was put in place for hoisting and pumping. A stamp mill was built, supplied with eight stamps and an engine, and got in operation in 1853. The number of stamp heads was soon after increased to 16. The company expected to find mass copper, and the mine yielded mainly stamp work

Some difficulty was naturally experienced in building up a mining enterprise in the midst of a wilderness, without the benefit resulting from the vicinage of older and similar establishments. The managers up to 1854 were Truman Smith, Clement Marsh, C. H. Nichols, Thomas P. Scott, with office in Washington, D. C.

Under a new management the stamp mill was enlarged, and the number of stamps increased to 40, a railroad track was laid from the mine to the mill; but in 1857 mining work was suspended, and in the following year the mine was leased to the Mabbs brothers. The underground workings are shown in the accompanying longitudinal section; the greatest depth is about 800 feet, and in length, 3,000.

The total product to the present time has been about 3,000 tons of refined copper. The lode has a width of from 15 to 20 feet, and a dip to the northwest of 55° to 60° with the horizon. It is an amygdaloid of brownish color, with epidote, quartz, calc spar, and prehnite scattered through it. The copper occurs in bunches or pockets.

The company began under a special charter, and was reorganized under the general mining laws of the State in 1857. Work was resumed by the company in 1863, and continued until 1870, when it again suspended, and the mine has since been worked on tribute. But in the meantime assessments had been made to the amount of $1,010,000. There has been built a large number of buildings and other surface improvements made, but at present these structures are in a ruinous condition. The stamp mill has for some years been run as a custom mill, doing the stamping, etc., for the tributers at this and at the other adjacent mines; it has a capacity of about 18 tons of rock per day.

The product of the mine for 1880 is 45,860 pounds of ingot copper. The stamp rock was sorted so that it yielded 9 per cent. The average yield of the mineral in refined copper was 80 per cent.

The agent for the property, Mr. Graham Pope, has now about 10 miners opening some new ground, and there is some talk of the company reorganizing. The present estate now consists of 420 acres—the N. ½ Sec. 1, T. 54, R. 34, and N. W. ¼ Sec. 6, T. 54, R. 35.

Secretary and Treasurer, F. W. Chapin; office in New York; Resident Agent, Graham Pope, Houghton.

THE GRAND PORTAGE MINING COMPANY.

The Portage Mining Company began work in the Portage vein, which lies parallel with the Isle Royal lode, and 200 feet distant from it. The bed is 10 feet to 15 feet wide. The first shipment was made in 1853, and consisted of about 10,000 pounds of barrel-work. The company worked until its capital stock was exhausted in assessments, when the work was suspended.

In 1860 the company reorganized as the Grand Portage Mining Company, and some work was done on the company account; but during many years the mine has been abandoned to tributers. In 1879 the property was purchased by parties in Hancock for a few thousand dollars, and a new organization made

with a capital stock of $500,000, and it is proposed to sell sufficient stock to realize a working capital. Mining work was begun a few months ago, and there are now about 40 miners employed in sinking and drifting below the old workings; the old mine reached to about 350 feet below the surface.

Work is being carried forward in both the Portage and the Isle Royal lodes, which are 400 feet apart, the workings on the former being one level below those of the other. Both are of sufficient width, 8 feet to 25 feet,—but there are stretches of barren ground, the copper being in bunches or pockets. The intention is to leave the poor ground to find that that will pay, and to stope it out. At present the mine is looking well. Each mine is provided with a hoisting engine.

There are 27 houses on the location, but no stamp mill. The Isle Royal lode dips at a greater angle than the Portage lode, so that their tendency is to come together. The product for the year—all tribute work—is 80,326 pounds of refined copper. In November, from 146 tons of rock stamped, 17,073 pounds of refined copper were obtained, stamped at the Isle Royal mill.

The work is now in charge of Capt. M. L. Tallon, who worked the mine 14 years ago, and is therefore familiar with it. The location comprises the S. W. $\frac{1}{4}$ Sec. 36, T. 55, R. 34. The company owns beside some timbered land, making in all, 800 acres. There is one-half mile of vein on the property. The company owns a lot on Portage lake, suitable, it is claimed, for a stamp mill.

The Secretary and Treasurer is Peter Ruffe, Hancock, Mich.

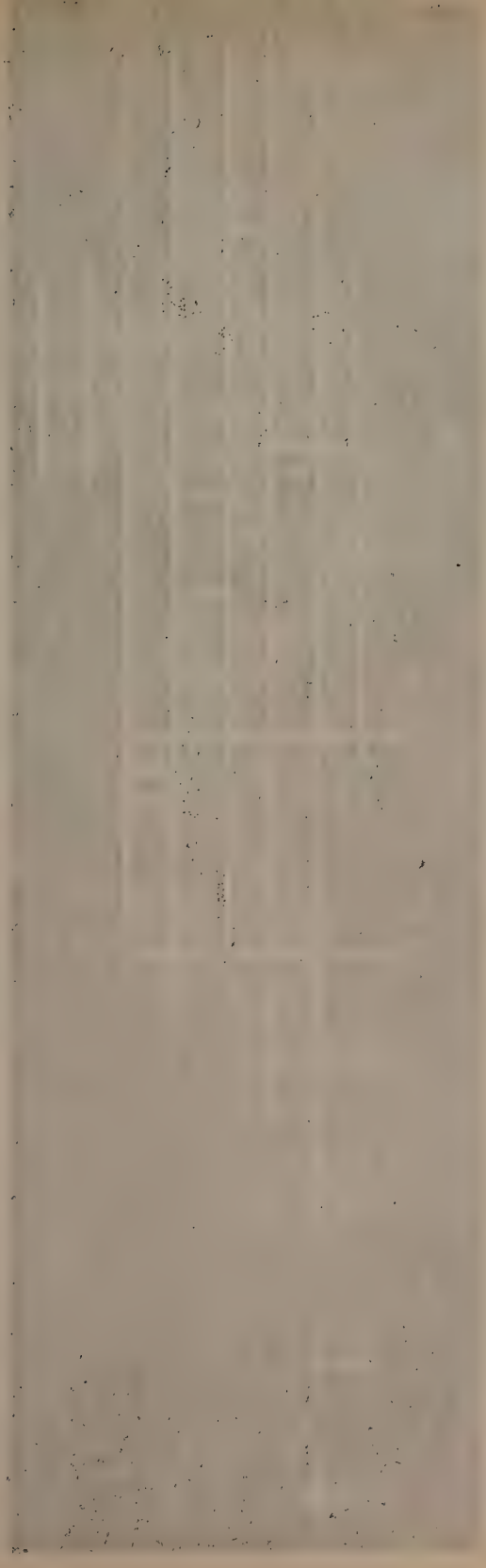
THE SHELDON AND COLUMBIAN MINING COMPANY.

This mine is located on the S. E. $\frac{1}{4}$ Sec. 36, T. 55, R. 34. The property joins the Grand Portage mine on the east, and is crossed in the northwest corner by the northeasterly extension of the Isle Royal and Portage lodes. The two—Portage, and Sheldon and Columbian—should constitute one mine. The whole could evidently be much more advantageously worked under one organization than by two distinct companies.

Work began on the Sheldon and Columbian location in August, 1853, inaugurated by the Albion Mining Cympany, that had previously been engaged in the Keweenaw district, on a location which it had recently abandoned.

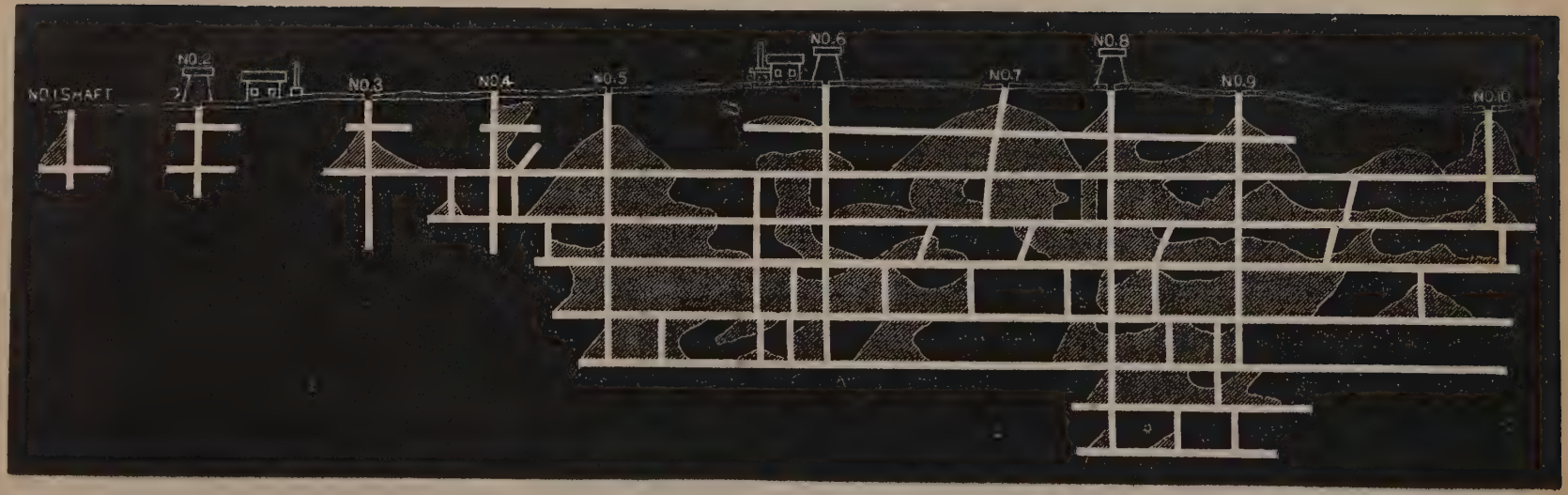
Three shafts were sunk on the Portage vein, and mining work was pushed forward with vigor, but in the end was attended with no better success than it had been in the vicinity of Eagle river, on the former location. And after spending considerable money, the operations were brought to a close in 1857. In 1860 the property was sold, and a new company, known as the Columbian, was organized, which began work in June of that year; but in 1861 the operations were again suspended, to be resumed the year after. The company continued to work the old mine, and started a cross-cut to the Isle Royal lode. A pumping and hoisting engine was first introduced to work in the mine in 1863. Up to March, 1864, the new company had received from assessments the sum of $130,000, and from the sales of copper, $2,281, derived from the total product of 7,254 pounds of mineral, yielding 5,496 pounds refined copper. In addition to the quarter section upon which the mine was located, the company owned 670 acres of timber land.

In 1864 the name of the company was changed to Sheldon and Columbian Copper Company—these two companies combining and reorganizing as one company, thus extending the location to Portage lake. The property was



LONGITUDINAL SECTION OF THE HURON MINE.

Scale, 300 ft. to one inch.



valued at $125,000. The mineral product for 1865 was 160,988 pounds, yielding 71.5 per cent, which sold for $35,099.49. The expenditures for that year were $120,000.

In 1866 a stamp mill was built and fitted with two Balls' stamps. The Sheldon property was the south fractional half of the northeast fractional quarter of section 36, so that the combining of the two companies gave to the new company the whole territory to the lake, thus affording dockage and site for stamp mill, etc.

The company shut down in about 1870, and the mine has since been worked to some extent on tribute. All the portable mining plant has been sold, including the Balls' stamps, which latter were purchased by the Osceola Company. The building, etc., yet remains standing. The company has called in $23 per share = $460,000 of its capital stock, for the expenditure of which it has little now to show. The product for 1880 is 46,931 pounds refined copper. The property is controlled by Mr. J. H. Forster, Houghton, Mich.

THE HURON COPPER COMPANY.

The estate of this company consists of 960 acres of land on the south side of Portage lake, and lying south and west of the Isle Royal mine. It has an extent of two miles on the mineral range, and is crossed by a number of veins, chief of which, so far as is known, is the Isle Royal lode. The description of the property is the S. ½ Secs. 1 and 2, T. 54, R. 34.

Work began in the Isle Royal lode on this location in 1855, but not until 10 years after was much copper produced. The total product of the mine has been about 4,000 tons of refined copper. The Isle Royal vein, from which this product has been obtained, has an extent on the property of about 3,000 feet, and increases in length with the descent, about 1 to 1. The length of the shafts opened in the mine are from 50 feet to 600 feet. No. 7 shaft is distant 1,200 feet from the Isle Royal line. The copper heretofore obtained has been got between No. 5 and No. 9 shafts, a lateral distance of 800 feet. The distance between the extreme shafts, No. 1 and No. 10, being the whole lateral extent of mine operated, is 2,100 feet. Upwards of $1,000,000 have been expended on the property, one-half of which has gone for surface improvments, buildings, and machinery. Houses for the accommodation of 400 or 500 men were built; a stamp mill was built, furnished with 48 heads of stamps —Gates' pattern, and with Collum's washers. The mill is situated on the Dacotah creek, 4,000 feet from the mine. The hoisting was done in No. 6 shaft, which is fitted with skip road, hoisting engine and winding drums, rock house, Blake's crushers, etc. From the rock house the product passed down a chute into cars that conveyed it along a track, laid mainly on trestle, 1,600 feet to the rock bin, from which it was drawn out through a chute into cars that conveyed it over a similar track, one-half the distance on trestle work, 2,400 feet to the stamp mill. During some years since 1871, until recently, the mine was known as the Houghton.

In 1879–80 the property was purchased by the same parties who own the Franklin, Pewabic, etc., and within the present year has been reorganized under the general mining laws of the State, with a capital stock of $1,000,000, divided into 40,000 shares. No copper has been shipped from the mine during the past year. The new company is now employing 80 men at the mine, getting ready for mining work. The direction of the work is in charge of

Capt. Johnson Vivian, Agent of the Franklin and Pewabic mines. The accompanying longitudinal section shows the workings up to the present time.

It is claimed that the Huron only needs the vigorous, intelligent management, which characterizes the management of the Atlantic mine, to make it correspondingly profitable.

The Atlantic, under former management, as the South Pewabic, expended $1,000,000, and abandoned the mine as practically worthless. But the new concern has shown that the deposit can be worked at a profit; a result that tends to stimulate mines like the Huron, working similar deposits, to accomplish a like result. The use of compressed air drills, high explosions, etc., have rendered it easy to get out a quantity of rock that was formerly impossible; and the improved machinery that has come into use in the mining work on the lake, gives facility for hoisting, tramming, stamping and washing the rock, etc., that adds to the ease and rapidity, and greatly reduces the cost, so that it is very possible that under the new management that has now taken hold of it, the Huron has a future that shall redeem its past record.

Office, No. 4 Exchange street, Boston, Mass.; D. L. Demmon, Secretary and Treasurer; Johnson Vivian, Agent, Houghton, Mich.

THE SOUTH PEWABIC COPPER COMPANY

began mining work in March, 1865, having organized under the general mining laws of the State, with a capital stock of $500,000; office in Boston; Wm. B. Frue, Superintendent. The mine was opened on the south side of Portage lake, on what was thought to be the Pewabic lode, on the S. ½ Sec. 4, T. 54, R. 34. The lode opened 10 feet in width, and was estimated to yield 2.5 per cent, but subsequent experience proved the vein rock to yield about one per cent of copper; $120,000 of the capital stock was paid in, which in the next three years was increased so that the paid up capital was $497,000, while the total expenses amounted to $1,105,464.98. The liabilities were $134,250, and the bonded indebtedness was $63,517. Under such a condition of affairs the stockholders naturally lost interest in the concern, and failed to attend meetings when there was little except failure to be reported, and reasons given why renewed calls for assessments should be made. Finally, the capital stock being exhausted, the company went into bankruptcy, and the property was sold to the parties who formed the Atlantic.

THE ATLANTIC MINING COMPANY.

This, the most important of the companies operating south of Portage lake was organized in December, 1872, by consolidating the South Pewabic and Adams Mining Companies, making a joint capital of $1,000,000, divided into 40,000 shares, $700,000 of which capital stock had been paid up before the consolidation took place. The indebtedness of both mines amounted, at the time of the reorganization, to $46,215.15, with cash on hand amounting to $9,004.42. In order to meet these liabilities, and to provide for current expenses, an assessment of $2 per share was made, payable February 1, 1873. On resuming work it was naturally found that the machinery and surface improvements were badly out of repair, and considerable preparation was necessary for re-opening and equipping the mines. A new engine—24-inch cylinder, 4-foot stroke,—with hoisting gear and pumping apparatus and boilers, was procured, new shaft house built, railroad and locomotive repaired.

The work of unwatering the mine had begun in August, 1872, and was completed in the following year, and a force of 150 miners was employed in sinking and in drifting, principally in the Adams mine. It required a good degree of courage and perseverance to undertake to carry on the working of this mine after the notorious failure which had characterized the operations under the old organization. But the new company took hold of the work, determined to succeed, and profiting by past errors has made for this mine a subsequent history that redeems its ignominious past.

The expenditures were greater than had been anticipated; labor ruled higher than was estimated, and it was also found necessary to build some additional tenement houses. The purchase of 2,000 acres of additional lands for timber was made. These were contiguous to Portage lake. The shipment of mineral to the close of navigation, 1873, was 929,267 pounds, which yielded 77 per cent = 714,711 pounds refined copper. The total production for the year was 863,366 pounds of ingot copper, all of which was stamp work.

But two of the four stamps were used, as the hoisting machinery proved to be insufficient to bring to the surface enough rock to equal half the capacity of the mill to work up. The assessments called for during the year amounted to $200,000, which, with the copper sold, made the total receipts $420,630.73. This sum was exceeded by the expenditures, and left an indebtedness at the close of the year of $5,831.07, rendering an additional assessment necessary, and the sum of $40,000 = $1 per share, was called for in February, 1874. The net mine expenses for the year 1873 were $377,542.95. The average cost for sinking shafts per foot was $38; winzes, $19.78; average cost per foot for drifting was $19.09; for stoping per fathom, $22.28. The number of tons of rock stamped was 51,088, with a total cost for stamping, washing, etc., of $53,608.70 = $1.05 per ton. Yield of mineral per ton of rock was 22 pounds = 16.21 pounds ingot. The force employed consisted of 219 miners, who received average monthly wages of $59.83; 55 surface men were employed, who received $50 per month.

In 1874 about one-third of the product was sent overland to market, at an extra cost of one cent per pound, but the gain in price above that obtained for the copper sent by steamer was three cents per pound. The product for the year was 931 1272-2000 tons, yielding 73.65 per cent = 1,372,406 pounds of ingot, which sold at an average price of 22 8-25 cents per pound. An additional assessment of $1 per share was made.

In the stamp mill two new rotating slime tables were added to the washing apparatus. Number of tons of rock stamped was 69,278, which yielded 26.07 pounds of mineral per ton, or 19.68 pounds of ingot to the ton. The cost of stamping and washing was 99.34 cents per ton, inclusive of all items pertaining to the stamp mill. The yield of ingot per ton of rock was an increase of three pounds over that obtained the previous year. A new pumping engine, hoisting engine, and locomotive were procured. The total force was 293 men.

The succeeding year, 1875, showed an increase of product, the total being 1,087 897-2000 tons, yielding 71.92 per cent = 1,567,036 pounds ingot copper, which sold for an average price of 22.47 cents per pound. The number of tons of rock stamped was 80,000, yielding 27.23 pounds of mineral to the ton = 19.58 pounds of ingot. The cost of stamping, washing, etc., 87.96 cents per ton of rock, inclusive of all work pertaining to the mill. There were employed 316 men, and 17 4-5 fathoms of ground were broken per man.

The trestle, carrying the launder to the stamp mill, was repaired, and other needed improvements made.

In 1876 there was a slight falling off; the product for that year was 1,338 1216-2000 tons of mineral, yielding 917 1041-2000 tons of ingot copper. The number of tons of rock stamped was 97,606, yielding 27.56 pounds per ton of rock = 18.96 pounds ingot. There was an average of the work of three stamps (Balls). The cost of stamping, washing, etc., was 67.09 cents per ton of rock, and the total force employed was 333 men. It was found, in working the mine, that the condition of the hanging wall required for safety that large pillars should be left frequently.

During 1877 a larger amount of work was done at the mine than in any preceding year of its history, and at the same time there was a corresponding diminution in cost, giving a net profit for the year's work of $42,880.55, and a surplus of $137,043.02. Several masses were obtained, the largest of which weighed 4,495 pounds. A skip road was fitted in No. 3 shaft, and the pumps put down to the ninth level. Six new dwellings were built. The total amount of rock carried one mile during the year was 330,562 tons, at a cost of 3.89 cents per ton per mile, including the cost of 102.5 tons of new rail. In place of the chutes at the mill, used to convey the rock from the end of the railroad to the mill, was substituted a double inclined-gravity railroad, with wire ropes and drums. At the top of the incline a rock house of 1,000 tons capacity was built. These changes, in addition to other advantages, saved the services of six men.

The total number of tons of rock stamped in the year 1877 was 105,780, which yielded 27.23 pounds of mineral per ton = 19.42 pounds of ingot per ton of rock. The total cost for stamping, washing, etc., including all expenses at the mill, was 57.79 cents per ton of rock. The expenses per cubic fathom of ground stoped was: For the year 1874, $62.62; 1875, $55.48; 1876, $52.27; 1877, $45.62, and the total cost of smelting and marketing per ton of rock was, for the same years respectively, $4.09, $3.90, $3.54, $3.07.

The product for the year was 1,440 378-2000 tons of mineral, yielding 71.32 per cent = 2,054,304 pounds ingot, which sold for an average price of 18.54 cents per pound, giving a surplus from which a dividend of fifty cents per share was paid. The company purchased 462 acres of adjacent lands. This land was obtained for the purpose of securing to the company the control of the stream of water and launder, which supplied the stamps, and for timber.

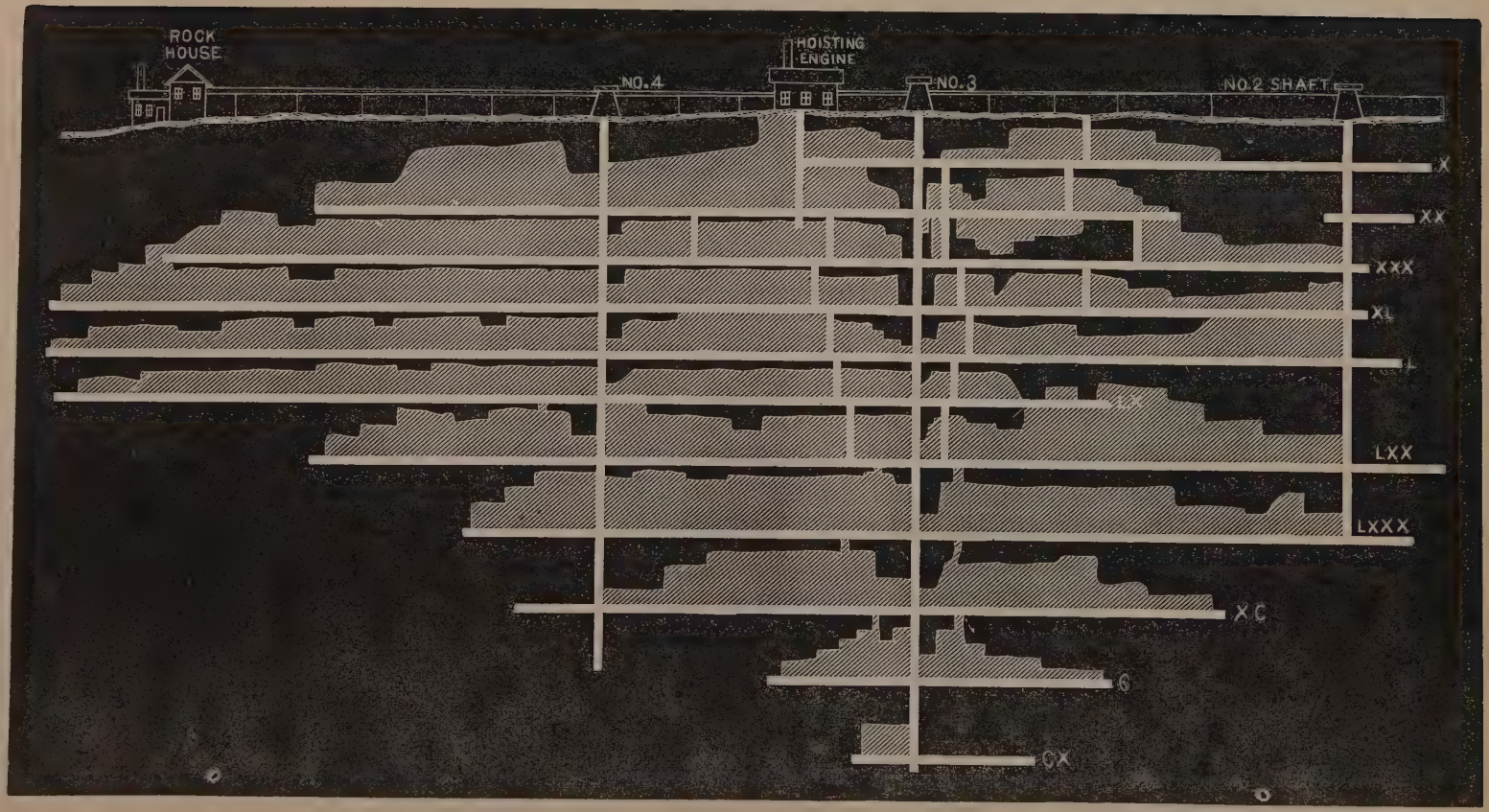
The product for 1878 was 1,423 1894-2000 tons, which yielded 70.44 per cent, or 2,006,075 pounds of ingot, and at an average price of 16.15 cents per pound, for which it sold, gave, for the year's work, a net profit of $11,325.06. After paying a dividend of $20,000, there remained in the company's treasury a surplus of $147,286.09. The low price of copper left but a small margin of profit.

Some changes in the management of the mine became necessary to secure harmony among the officers, and Capt. Wm. Tonkin, the mining captain, was chosen agent. The cost per fathom for stoping was $14.46; per foot for drifting, $10.06. The number of tons of rock stamped was 111,709, which, including the other expenses at the stamp mill, cost $54,579.38 = 48.85 cents per ton. The yield of mineral per ton of rock stamped was 26.54 pounds = 18.5 pounds of ingot.

Considerable improvements were made; two additions were built to the stamp mill, 110x25 feet, and 80x25 feet; the washing apparatus was increased by the addition of three Evan's slime tables, and 14 Collum's washers; a new engine house was built, and the arrangements perfected for bringing the supplies and materials from the dock by railroad, instead of hauling with teams, as had

LONGITUDINAL SECTION OF THE ATLANTIC MINE, JAN., 1881.

Scale, 300 ft. to one inch.



been heretofore done; a shop, three houses, a truss bridge, 180 feet long, over Coles creek, were built; also a new rock house and engine house at the mine were built, and a new 24-inch cylinder engine, with boilers and other necessary machinery for driving the crushers were procured.

The product of mineral in 1879 was 3,257,085 pounds, which yielded 71.81 per cent = 2,339,073 pounds of ingot, and sold at an average price of 16.3 cents per pound; a dividend of $1 per share was declared. The two shafts, Nos. 3 and 4, being worked at their full capacity, it was determined to fit up No. 2, which is 790 feet north from No. 3, into a working shaft.

The general expenditures up to the close of 1879 amounted to $3,294,337.40; total receipts from the sales of copper were $2,304,548.68; total assessments, $280,000; number of tons of rock stamped, 122,668 tons, yielding 26.55 pounds per ton = 19 pounds of ingot. The total cost of stamping, washing, etc., including all expenses at the mill, was 42.44 cents per ton.

During the past year there has been done 188 feet of sinking, at a cost of $18.04 per foot; 2,118 feet of drifting, at a cost of $12.90 per foot; 9,521 cubic fathoms of stoping, at an average cost of $14.35 per fathom; 169,825 tons of rock have been treated at the stamp mill, at a cost of 38.13 cents per ton, yielding 19.74 pounds of mineral per ton = 3,352,190 pounds, yielding 72.28 per cent ingot = 2,423,225 pounds refined copper. The net value of the product for 1880 is $467,426.43; the operating expenses were $384,083.76; profit for the year, $84,391.01; cost for construction, $23,849.66, leaving the net gain, $60,541.35; net surplus January 1, 1881, $263,320.02; total assets, $372,555.30; total sales of copper to date amount to $2,761,372.01; dividends paid in 1880, $60,000; total expenditures to January 1, 1881, $3,853,201.99.

One side of a Rand duplex compressor and engine were put in, and 1,000 feet of 7-inch pipe, and 2,000 feet of 3-inch pipe, to convey the air to the power drills, were laid in the mine.

The Adams location was the S. ½ Sec. 4, and the South Pewabic the N. ½ Sec. 9, T. 54, R. 34. The latter went into bankruptcy and the property was bought from the bankrupt court. The same parties bought both mines. In the Adams mine but little stoping had been done, and but two levels had been sunk. The purchasers organized the Atlantic, and have since bought the land between the location and the lake. The mine is on the South Pewabic lode, which carries a width of from 10 feet to 21 feet, and possesses a good degree of uniformity. It is a dark colored, friable amygdaloid, somewhat similar to the ash bed in Keweenaw county. The dip is 45° to the northwest, and bears about N. 35° E. There are three working shafts connected by an elevated railway, on which the cars are drawn to the rock house south of the south shaft, where after being crushed it drops into the bins, and is drawn out into the cars that convey it to the stamps, over a railroad three miles long, four feet, one inch gauge. The railroad is operated by locomotives, of which there are four. The cars dump into a chute that conveys the rock into a large bin of 2,000 tons capacity, whence it is drawn out into cars that operate on automatic tracks, connecting the large bin with smaller ones, one for each stamp, of 200 tons capacity, from which the rock is drawn out under the stamps. The railroad and dock are connected with an incline operated by a stationary engine, which hauls up the supplies.

The copper is sent down to the dock on a gravity incline, which connects it with the stamp mill. In the mill are 4 Ball's stamps, 56 Collum's washers, and 9 Evans' slime tables, and they are now treating 480 tons of rock per day. The water for the stamps is brought by launder two miles from a dam in Cole's

creek. The launder has a fall of but one-eighth of an inch in 16 feet; the size is 16x16 inches. It was originally tried, by the former company (South Pewabic), to pump up the water from the lake, but the trial was not successful, and the launder was substituted. It is carried over ravines, in one instance on a trestle 150 feet high.

The mine has now attained a depth of 1,000 feet. The underground workings are shown in the accompanying longitudinal section.

The percentage of copper in the mineral got out at the stamp mill is less than it would be, but for an appreciable amount of iron ore that having a nearly equal specific gravity cannot be separated from it. The iron ore comes mainly from the trap which is taken from the walls of the vein. Owing to imperfect cleavage, more or less trap at the margin is mixed with the vein matter, and goes to the stamp.

The cars running on the elevated track from the shafts to the rock house carry two skip loads to a car, obtained at two shafts. The cars dump on an inclined screen, which allows the smaller portions to pass through into small breakers, from which it drops into the bins. The large pieces slide down the bars on to the floor and are sorted. There are two large breakers, and two of medium size. Through these the rock passes into the bins. In these are a row of shutes on each side for loading cars on the two tracks that enter the building.

There is a locomotive shop for repairs. The company have a fine pumping engine, erected in 1876,—one of the finest on the lake, 18 inch cylinder, 8 foot stroke; and two hoisting engines with friction gear and winding drums, and a hoisting engine at the south shaft with geared hoisting apparatus. A good store is conducted by the company, well stocked, and made a separate affair.

A year ago an air compressor was put in, and five drills have since been at work in the mine, and Captain Tonkin finds, by carefully kept estimates of the expenses attending their use, that there is a saving of $1,000 per month, the matter of saving in time not being taken into account. Each drill, with six men, will stope 60 fathoms per month. By barrel-work the same number of men will stope from 25 to 27 fathoms per month. The cost per fathom with the drill is about $10, and by hand labor it is $17, a saving of $7 per fathom. The drainage is run into sumps at the shafts and thence pumped to the surface. The rock house is 80x40 feet, and the engine house of the same size.

There are 113 dwelling houses in the location, and a population of about 1,200 persons. The number of employés is 400, of whom 240 are miners. The average contract wages underground are $50 per month, surface $45.

President, Jos. E. Gray; Secretary and Treasurer, J. M. Stanton, Jr.; Agent at the mine, Captain William Tonkin; office, No. 76, Wall st., New York.

THE QUINCY MINING COMPANY.

This great mine, second only to the more celebrated Calumet and Hecla, of the copper mines of Lake Superior, was early incorporated by a special charter, granted by the legislature of the State of Michigan, in March, 1848, with a capital stock of $200,000 in 20,000 shares. The lands owned by the company comprised 627 acres of mineral land, on Secs. 26, 34 and 35, T. 55, R. 34, and 227.5 acres of timber lands situated in townships 33 and 54, ranges 33 and 32, three or four miles distant from the mine and on the borders of Portage lake.

Previous to 1856 no satisfactory progress was made, but at that time the discovery of the so-called Pewabic lode on the company's property caused the out-

look for the future to become cheering, and the work which had nearly ceased, was henceforth prosecuted with vigor, in the direction of opening and developing the newly discovered vein. But not until the close of 1860 did the company begin to receive any remuneration for the previous expenditures. That year the mine returned a profit of upwards of $44,000. The total expenditures up to 1856, amounted to $42,097.98, and from the time of organization to August 1, 1861, the total expenditures were $916,670, of which amount $200,000 had been derived from assessments, making it fully paid up; $600,000 were obtained from the sales of copper produced. The company had in operation 64 heads of Wayne's stamps and was employing a force of 185 miners. The mine adjoins the Pewabic on the west, and comprises the whole of Sec. 26, except the southwest quarter, and has an extension on the Pewabic vein on the property, of 5,800 feet. In the following year, 1862, the company began the payment of dividends. In 1863, the product was 1,472 1472-2000 tons, yielding 82.17 per cent of ingot copper, nearly all of which was stamp work. This sold for $824,504.66. The company also purchased two sections of wood lands and paid in dividends $240,000, leaving a working capital of $120,000, and also purchased a steam tug for hauling wood and timber from the shores of Portage lake to the location. The total number of tons of rock stamped for that year was 50,670, at a cost of $1.27½ per ton. The average price paid for sinking shafts was $23 per foot, winzes $14, drifting $12.17, per fathom for stoping $19.20.

In 1864 the shipment was 3,102,532 pounds of mineral, yielding 82.5 per cent = 2,498,574 pounds of ingot, which yielded a gross sum of $1,120,482.52, and the total expenses were $667,512.57, leaving a profit of $452,969.95 on the gross work, from which dividends to the amount of $320,000 were declared.

Further explorations for determining the value of the mineral veins on the company's property were undertaken. An adit across the formation from the Pewabic vein to the Albany and Boston conglomerate was begun. The number of tons of rock stamped was 47,445 at a cost of $1.90 per ton. Cost per foot for sinking shafts, winzes, and for drifting, were respectively $40.72, $21.91, $17.92. Average price paid per fathom for stoping was $23.89. Number of men employed was 646, of whom 242 were miners, who received on contract an average price of $65.50 per month. The average yield of mineral per cubic fathom was 697 pounds = 562 pounds ingot. The product of the mine for 1865 was, 1,360 1980-2000 tons, yielding 81.36 per cent ingot. A portion of the product wrecked in a vessel on Lake Huron occasioned a loss to the company of $20,000. The total dividends paid up to February, 1865, were $699,000.

The total amount of rock treated in the stamp mill was 48,557 tons, at a cost of $1.85 per ton. Average price per fathom for stoping was $24.40; cost per foot for sinking shafts, winzes, and for drifting were $33.73, $20.82, $18.25; yield of mineral per fathom of ground broken, 618.5 pounds = 501 pounds of ingot; number of men employed, 654; number of miners, 212; wages of miners, $57.53.

In 1866 the shipments of mineral were 2,529,572 pounds, yielding 83 per cent = 2,114,220 pounds of ingot, which sold for $661,107.11, and the total expenses were $610,833.25, leaving a profit on the year's business of $50,273.86. A man engine, working down to the 90-fathom level, was built at a cost of $17,448.39. The exploring, with the exception of driving the adit, was given up. The stoping per fathom, sinking shafts and winzes per foot, and driftings cost respectively, $22.40, $27.39, $19,64, $15.74. The number of tons of

rock treated in the stamp mill was 49,903, and cost for treating, $1.667 per ton. The yield of mineral per fathom was 541 pounds = 451 pounds of ingot. The average force employed was 598 men, of whom 227 were miners, receiving $53.16 per month.

The shipments for 1867 were $2,358,639 pounds, yielding 81.46 per cent = 1,921,620 pounds ingot, from the sale of which was realized the gross sum of $437,482.75. The total expenses amounted to $363,572.02, leaving a profit for the year's work of $73,910.73, from which a dividend of $60,000 was declared. The land under cultivation was found to yield an abundance of hay, oats, potatoes, etc.

The number of tons of rock stamped was 37,774, yielding 2,068,885 pounds of mineral, at a cost of $63,595.89. Cost of treating per ton, $1.68; average cost for sinking shafts, winzes, drifting per foot, $28,36, $17.64, $14.46; per fathom for stoping, $19.74; average sales, 24 cents per pound; average of yield of mineral per fathom, 646 pounds = 526 pounds ingot; number of men employed, 370—miners, 167; wages, $50.83 per month; cost of mineral ready for smelting, 13.63 cents per pound; cost, including smelting, sale, etc., 20 cents per pound; price received, 24 cents per pound.

In 1868 the number of barrels shipped was 1,713,248, mineral, yielding 82.34 per cent = 1,410,759, and 7,182 pounds washed from the tailings, making the total of ingot, 1,417,941 pounds, which sold for $357,078.39. The expenses for the year were $327,094.81, leaving for profit $29,983.58. A dividend of $2 per share was paid. There was a large falling off in the yield of the mine below that of the previous year. It was discovered that the vein had separated into two parts, the larger and more productive portion dipping nearly vertically, while the openings in the course of the work had been made in the branch vein. The main vein was recovered by a cross-cut, and thence a system of cross-cutting and new openings had to be resorted to at a loss of time and of product.

The cost per foot for shafts, winzes, and drifts was respectively, $24.94, $14.92, $12.93; per fathom for stoping, $19.43; yield of mineral per fathom, 519 pounds = 427 pounds of ingot. The number of tons of rock stamped was 36,557, at a cost for treating in the mill of $1.28 per ton. Average number of men employed, 346; of miners, 157; average miners' wages, $50.44; the average cost per pound for producing the mineral ready for smelting, 15.87 cents; total cost per pound, including smelting, sales, etc., 22.5 cents; average price per pound, sold for, 24 5-8 cents. Capt. George Hardie, who had been in the employ of the company since its organization, resigned, and was suceeded in the agency by J. N. Wright.

In 1869 the product showed that the previous falling off in yield had been but temporary, and that the vigorous work that had been undertaken had its effect in bringing the mine back to its former production. The shipments for the year were 2,878,128 pounds, which yielded 82 per cent = 2,417,365 pounds of ingot copper, and sold for $529,081.87; the total expenditures were $403,573.38, leaving a margin of profits of $125,505.49 from the earnings; a dividend of $6 per share = $120,000 was declared. The man engine was extended down to the 130-fathom level. Number of tons treated in the stamp mill, 56,767, at a cost per ton of $1.06¾. The cost of the mineral ready for smelting was 11.7 cents per pound; cost, including all expenses, 16⅓ cents per pound; price received per pound = 21.85 cents; cost per foot for shafts, winzes, and drifts, was respectively, $25.04, $15.98, $13.24; average price per fathom for stoping, $18.91; yield of mineral per cubic fathom, 531 pounds

=446 pounds of ingot; average force employed, 429 men, of whom 210 were miners, who received $51.10 per month.

The shipments for 1870 were $2,952,742 pounds of mineral, which yielded 84 per cent = 2,496,774 pounds of ingot, which yielded a gross sum of $538,170.23; the total expenditures were $383,709.67. A dividend of $4 per share was declared. Each year a special sum of $50,000 had been set aside for insurance and contingencies. The work of the stamp mill was 55,027 tons of rock treated, at a cost of $1.15 per ton. Cost of the mineral ready for smelting was 10.5 cents per pound; total cost of ingot, including sale, etc., 14.9 cents per pound; average price received, 21 cents per pound; the average cost per foot for shafts, winzes, and drifts was, respectively, $31.99, $16.42, $13.48; cost per fathom for stoping, $17.96; yield of mineral per fathom, 624 pounds = 528 pounds of ingot; average number of men employed, 422; of miners, 181, who received $46.09 per month.

In 1871 the company shipped 3,011,074 pounds of mineral, which yielded 80¼ per cent = 2,409,501 pounds of ingot, and sold for $549,729.74. The total expenses were $365,513.50. During the year the sum of $340,000 was paid in dividends. More ground was broken in 1871 than in the previous year, and with less yield of mineral, and a smaller percentage of ingot—due to a decrease in the richness of the vein. The machinery was procured for the introduction of steam power drills into the mine, and a rock house at the head of the railway incline was built and connected by railway with the shafts, and was furnished with Blake's crushers.

The number of tons of rock treated at the stamp mill was 59,757, at a cost per ton of $1; total cost of mineral ready for stamping, 10.6 cents per pound; cost of ingot per pound, including sale, etc., 15 3-5 cents per pound; average price received, 23.5 cents per pound. The cost per foot for sinking shafts, winzes, and for drifts was $28.22, $16.43, $13; average price paid per fathom for stoping, $18.44; the yield of mineral per fathom, 551 pounds = 441 pounds ingot; number of men employed was 440, of whom 104 were miners, who received $47.08 per month.

In 1872 the shipment of mineral was 2,795,949 pounds, yielding 81.12 per cent = 2,269,104 pounds ingot, which sold for $725,096.72. The total expenses were $522,107; total net earnings for the year, $213,543.67. The dividends paid during the year amounted to $350,000. The business office, which, up to 1872, had been in New York, was removed to Boston, with a new board of directors and Horatio Bigelow as President, and W. R. Todd, Secretary and Treasurer. Up to this date the president had been Thomas F. Mason. Mr. A. J. Corey, former clerk of the mine, was appointed the agent.

The number of tons of rock stamped, etc., was 60,828, at a cost per ton of $1.065. The cost of mineral per pound was 16.44 cents; the cost of the ingot per pound, 22.93 cents; amount received per pound, 32.5 cents; the cost per foot for shafts, winzes, and drifts was $36.62, $19.32, $17.36, and the cost of stoping per fathom, $20.81; yield per fathom, 482 pounds = 391 pounds of ingot; average number of men, 487, of whom 233 were miners, who received average contract wages of $60.62 per month. It will be seen that there was a less amount of copper obtained, while a greater amount of rock was stamped, and that there was a falling off in the yield per fathom. This was due to the "pockety" character of the vein, which is rich in places, with stretches of barren ground, and in the 170th and 180-fathom levels, which were worked at this time, a less amount of productive ground was found, the lode in these levels proving comparatively lean in copper, making it necessary to break a

larger quantity of ground to a given amount of mineral. The steam drills which had been on trial during the year proved too unwieldy for general mining work, and their use was abandoned, except for special purposes.

In 1873 the company shipped 3,200,180 pounds of mineral, which yielded 81.9 per cent = 2,621,087 pounds of ingot; to obtain which, 63,272 tons of rock were stamped at a cost of $1.209 per ton; the cost per pound of mineral was 13.31 cents; of ingot, including cost of sale, etc., 18.57 cents per pound; average price received was 26.5 cents, which sold for a gross sum of $722,408.47. The total expenses were $519,902.67 from the net earnings; a dividend of $8 per share was declared. During several years the company had sold lots in Hancock, that village having been laid out in the Quincy estate. Some excellent results were obtained in 1873, which speak well for the local management. A cross-cut was started in the 180-fathom level, north of No. 1 shaft, for the purpose of testing the ground to the eastward, and was driven 60 feet, striking a soft healthy vein well charged with copper. Drifting to the south developed rich ground. Another cross cut was started 130 feet south from No. 1 shaft, which also cut the lode, and the two cross cuts were connected in the new lode. Here a wide, rich vein was opened that yielded a large amount of stamp and barrel-work. The vein to the north of No. 2 shaft in the lower levels having narrowed to two feet width and become hard and compact, a cross cut was started in the 210-fathom level to the east, at a point 24 feet north of No. 2 shaft, which, after being driven 60 feet through hard compact trap, cut a promising vein that, being opened south from the cross cut, developed to 9 feet in width.

The average price paid for shafts, winzes and drifts per foot was $34, $19.03, $16.16; average price paid per fathom for stoping was $21.26; yield of mineral per fathom of ground, 600 pounds = 491 pounds ingot; average number of men employed, 489, of whom 223 were miners, who received per contract wages $62.42.

The shipments of mineral in 1874 amounted to 3,626,350 pounds, which yielded 84.125 per cent = 3,050,154 pounds ingot. This product was obtained from 67,112 tons of rock stamped (being 80 per cent of the rock hoisted) at a cost per ton for stamping, working, etc., $1.085. Cost of mineral per pound, including all expenses, 12.87 cents; cost of ingot per pound, including all expenses and sale, 15.13 cents; average sale of shipments per pound, 21.88 cents; making the gross earnings, with silver sold, $656,083.16; the total expenses were $461,088.54. A dividend of $8 per share was declared. The cost per fathom for sinking shaft was $30.27; winzes, $16.73; drifting, $14.67; price per fathom for stoping, $20.15; yield of mineral per fathom, 685 pounds = 577 pounds ingot; average force employed, 468 men, of whom 234 were miners, who received $48.38 contract wages.

The largely increased yield for the year is seen to be in a great measure due to the increase of copper per fathom, showing an improvement in the character of the vein, as depth was obtained, but chiefly the advantage came from the east branch, which had been opened the year previously. This new ground proved to be of increased width and richness, giving a greater amount of stoping ground and a greater facility for working as well as increased yield for amount of ground broken.

In 1875 the office of the company was returned to New York and the former officials reëlected: Thomas F. Maston, President; W. R. Todd, Secretary and Treasurer.

The shipments for that season were 3,404,345 pounds of mineral, which

yielded 82 per cent = 2,798,281 pounds ingot, from sales of which, with the silver obtained, the gross sum of $653,168.08 was realized; the expenses aggregated $456,816.66; this balance, with other assets, constituted a sum of $485,004.14, from which two dividends, making $160,000, were paid. The mining operations of the year developed some of the peculiar changes that have ever characterized the working of the Quincy lode, which, however unfavorable it may sometimes appear, always has been found to recover its productiveness as the work has been pushed, so that the confidence in the lode has become so well established that though there may be occasional cause for anxiety, there is never discouragement. There was a falling off of 92 pounds of mineral per fathom in the yield, and a reduction in the percentage of mineral, and it was early in the season discovered that the lode at the points which had been relied upon for the year's product was much narrower than was expected, and it became necessary to push forward with increased vigor to open new ground. Full 50 per cent more drifting and 6,000 fathoms more stoping were done than were done the year previous.

The ground to the north, towards the Pewabic, having been neglected for several years, the 180-fathom level was started in that direction, and after passing through 80 feet of contracted, non-paying ground, opened into a wide, rich lode, which proved especially favorable. Other explorations were made that kept the openings well ahead of the needs of mining work.

There were 70,401 tons of rock stamped, at a cost of 96.5 cents per ton. Dividing the total expense by the number of pounds ingot, gives the cost per pound, ingot, 16.32 cents. The gross sales were 19 cents per pound; price paid for sinking per foot: Shafts, $35.12; winzes, $15.51; drifting, $14.01; average price per fathom for stoping, $19.73. The yield per fathom broken was 591 pounds = 485 pounds ingot; about 15 per cent of the rock hoisted was rejected. Average number of men employed, 504, of which 217 were miners, who received an average contract price of $46.74. The year 1876 showed a larger product than had been obtained any previous year, while the sales were unprecedentedly low. The larger portion of the product came from the new ground opened to the north of No. 1 shaft, and from the east branch deposit, north of No. 2 shaft, and the resources of the lode at these points gave no indications of being exhausted.

The year's shipments aggregated 3,815,850 pounds mineral, which yielded 80.53 per cent ingot = 3,073,171 pounds ingot. The cost per foot for sinking shafts was $36; winzes, $14.64; drifting, $12.92; average price paid per fathom for stoping, $18.83; the average yield per fathom was 629 pounds mineral = 507 pounds ingot; the number of tons of rock treated at stamp mill was 44,177; the number of tons poor rock rejected was 10,026; the cost per ton for treating the rock was 91 cents; the total gross receipts for copper and silver were $591,226.66, and the total expenses $461,032.48, which latter amount divided by the number pounds ingot, gives 15 cents the cost per pound; the average price received was 16 cents; the average number of men employed, 510, of whom 227 were miners, who received average contract wages of $47.13; dividends amounting to $160,000 were paid.

During the year 1877 the copper interests continued depressed, but a greater economy in the company's expenses resulted in a saving of $5,000 in the running expenses for about the same amount of work as had been done the year previous. No additional sinking was done in the main shafts, the underground work being mainly done in the way of pushing the levels to the north

and south. The shipments for the year were 3,450,150 pounds of mineral, yielding 82.23 per cent = 2,837,014 pounds ingot, which sold for, including silver, $506,057.90. The expenses were $399,407.20; a dividend of $5 per share was declared. The number of tons of rock stamped was 75,307, at a cost of 94.9 cents per ton. The expenditures divided by the number of pounds of refined copper, show a cost per pound of 13.5 cents; the average price received was 15 cents; cost per foot for sinking in shafts was ———; winzes, $13.44; drifting, $17.29. Average price paid per fathom for stoping was $17.29; average yield of mineral per fathom, 568 pounds = 467 pounds ingot; average number of men employed, 474, of whom 249 were miners, who received $43.79 for contract wages.

The original charter of the company having expired in March, 1878, a new company was formed, retaining the same title, under the general mining laws of the State of Michigan, with a capital stock of $1,000,000, divided into 40,000 shares of $25 each. The year's product continued to be obtained chiefly from the new openings in the north and south ends of the mine, but a low percentage in yield of the rock stamped compelled the stoping of upwards of 1,000 fathoms additional ground to make up the deficiency in mineral. The pockety character of the lode was unusually manifest, affording an increased amount of mass and barrel-work, being 48 per cent of the whole product. Many of the new openings were in unproductive ground, and a good deal of care and energy was requisite to keep up the product. In the progress of the underground explorations constant use has been made of the diamond drill, and it has been found that by no other available means could so much have been accomplished.

The average assays for the year of the waste sands show a loss of only 185-1000 of one per cent. The shipments for the year were 3,554,210 pounds of mineral, yielding 84.18 per cent = 2,991,050 pounds of ingot; receipts, $447,510.50; expenses, $401,849.17. In 1879 the shipments were 3,161,175 pounds, which yielded 83.5 per cent = 2,639,958 pounds of refined copper. The total sales were $445,506.44; the total expenses, $382,064.75; the total profits were $75,541.70; assets January 1, 1880, $455,567.93; dividend, $3 per share. A saving of $18,000 in expenses was made as compared to the previous year. The openings were in poor ground, and a large extent of hard, narrow lode was encountered; 3,000 tons less of rock were stamped than the year before.

The diamond drill explorations were continued through the year, but the only discovery made of importance was that north of the man engine winze, in the 230-fathom level; cross-cuts were started to reach this ground. The air compressing machinery was increased, it having become established that in mining work the power drill is one of the chief elements of success. The increase of facility enabled the use of five additional Rand's drills. The man engine was carried down to the 240-fathom level.

On the last day of the year 1879, the rock house was burned to the ground; a serious matter in the light of expense, and still more, as occasioning delay in the production of mineral. Preparations were immediately made for the building of a new rock house, and it was completed in March, 1880. It is situated at the top of the bluff, and is connected with the stamp mill, on the bank of the lake, by a double track, gravity-incline, 2,200 feet in length. The track connecting the shafts with the rock house is 1,465 feet in length, and the cars conveying the rock, which run over this track, are drawn by wire rope and stationary engine.

The underground workings of the mine are shown in the accompanying longitudinal section. The mine is now down to the 28th level, a distance, on the lay of 56°, of 2,000 feet.

The largest mass ever found in the mine is now being cut up in the 170th level, about 50 feet N. from No. 2 shaft, and will weigh about 20 tons. The masses usually found are not to exceed five tons in weight. The product is about 40 per cent mass and barrel-work, and 60 per cent stamp. Two loaded cars go down at a time on the incline, and two empty ones ascend the track. The cars have a capacity of two tons each. The mill has 80 Wagner's stamps. In October, the yield of mineral from the stamp rock was 4.5 per cent; for the year 1880, it is 2.5 per cent. The following table shows the percentage of mineral from the rock, for the entire period, since the mill started:

Year.	Per Cent.	Year.	Per Cent.
1861	2.55	1871	2.29
1862	2.03	1872	2.17
1863	2.75	1873	2.60
1864	2.96	1874	2.61
1865	2.60	1875	2.44
1866	2.63	1876	2.38
1867	2.74	1877	2.11
1868	2.25	1878	1.76
1869	2.48	1879	1.80
1870	2.61	1880	2.50

From the above it will be seen that in 1878 and 1879 the percentage of yield ran the lowest of any period, but in 1880 the mine again resumes its normal condition of productiveness.

The product for 1880 is 2,201 tons, 140 pounds, yielding 82 per cent of ingot copper. Total dividends paid, $2,390,000.

Thomas F. Mason, President; Wm. R. Todd, Secretary and Treasurer, No. 4 Exchange street, New York; A. J. Corey, Agent; John Cliff, Mining Captain, Hancock, Michigan.

THE PEWABIC MINING COMPANY.

The Pewabic mine has ever been a favorite among the mining men on Portage lake, and a great deal of satisfaction is felt over the more recent active policy of the company, and the nearly certain prospect of the mine renewing again its old-time, prosperous career. The company was organized in 1853, owning 1,205 acres of land in Secs. 9, 10, and 25, T. 55 N., R. 34. The mine was opened on the Pewabic lode, in the northwest corner of section 25. The lode crosses the corner of the section at an angle of N. 33° E., and dipping to the northwest 56° to the horizon. The portion of section 25 owned by the company is 485 acres, extending to Portage lake. Up to 1855 the company had realized from the product of the mine the sum of $26,363, and there had been paid in from assessments the sum of $75,000. But in October, of that year, mining work on a much increased scale, and under the supervision of Mr. Charles H. Palmer, was begun, resulting, for succeeding years, as follows:

YEAR.	Total Expenditure.	Mining Expenditure.	Mineral Product in Tons and Pounds.	Mining Cost Per Ton.	Per Cent of Copper.	Tons and Pounds of Ingot.	Assessments.	Total Per Ton Expenditure.	Net Value of Product.
1855	$26,357 75	$19,362 04	19 344-2000 t's	$1,008 07	60	11 174-2000 t's	$15,000	$2,378 48	$1,080 14
1856	40,820 54	34,674 31	36 1548-2000 t's	358 27	68	65 1646 2000 t's	-------	627 75	31,482 23
1857	59,484 96	37,820 50	204 684-2000 t's	185 08	58	118 254-2000 t's	20,000	500 68	44,058 29
1858	109,152 95	55,212 13	379 1136-2000 t's	145 46	54.5	208 603-2000 t's	20,000	526 46	76,548 02
1859	----------	----------	1,487,458 lbs	----------	69½	1,029,949 lbs	--------	----------	197,597 02
1860	----------	----------	1,943,837 lbs	----------	69¼	1,917,426 lbs	--------	----------	322,317 32
1861	----------	----------	2,225,268 lbs	----------	79	1,849,192 lbs	--------	----------	295,951 57
1862	----------	----------	2,051,789 lbs	------- ---	76.7	1,571,281 lbs	--------	----------	303,901 84

The whole number of superficial fathoms of vein surface opened at this date (1862) was 15,615, and during the preceding year the yield of copper per fathom was 966⅔ pounds of ingot. Average price paid per fathom for stoping, was $21.75; for drifting, and for sinking shafts and winzes, the price per foot was, respectively, $11.25, $30, $12. There were six shafts, having a total depth of 2,047 feet, the lowest, No. 4, being down 552 feet. The average cost per ton for stamping, washing, etc., 91 cents. The mill had a capacity of 150 tons per day; it was provided with two Ball's stamps; 7.15 tons of rock were stamped per cord of wood consumed. The amount of copper lost, from the mill, was found to be 1 1-55 pounds per ton of rock treated in the mill. The tailings were washed by tributers, the company receiving two-fifths of the product thus obtained. Some farming was done in 1861; 2,000 bushels of potatoes, 30 tons of hay, etc., were raised on the location. In the same year, also, was added to the mining plant a powerful hoisting engine, the services of which had become indispensable to the advantageous working of the mine. During the year 1862 the directors were enabled to pay to the stockholders $100,000 in dividends, $25,000 more than the capital stock which had been paid in. The total expenditures, $363,000, had thus all been met by the earnings of the mine, and a surplus of $60,000 over and above all liabilities remained for a working capital. No. 4 shaft had attained a depth of 637 feet, and the vein was apparently increasing in capacity and in richness and facility of working.

In the year 1862 the company paid $10,200 to the Portage River Improvement, and also loaned $6,359 to the Portage Lake Manufacturing Company, an enterprise, as heretofore stated, which had just started, and whose success it was in the interest of the mining companies to promote. The success attending the Albany and Boston Company in the conglomerate belt which it was working induced the agent of the Pewabic, Mr. J. H. Forster, to drive a crosscut to intersect the same lode on the Pewabic property, which work was consummated in September, 1864. Encouraged by the promising appearance of the vein thus intersected, he ordered an additional set of Ball's stamps and washers for the stamp mill; the whole bulk, 160 tons weight, was brought from Cleveland by steamer, and safely landed at the company's dock in November. By the advice of the agent, one-half of this new machinery was sold to the Franklin Mining Company. Up to this time the Pewabic lode was the only one which had been worked. The lateral extent of the openings on this vein by the Quincy, Pewabic, and Franklin Companies, was about one mile, and the extreme depth was 900 feet, averaging 600 feet. The yield of copper since the vein was fairly opened, in 1855, had been 19,915 tons, which had been sold for $8,258,793.54, and the vein seemed to possess undiminished richness as greater depth was attained. The sum of the depths attained by the shafts in

1864 was 2,981 feet, the deepest, No. 5, being 900 feet. Many improvements were made, among which were the erection of 40 dwelling houses for the accommodation of the men, a new engine house on the conglomerate lode, an addition to the stamp mill for the new machinery, and the tram road laid with new ties and rails, a new saw mill, with engine, boilers, etc.

The two new stamp heads were found to do double the work of the old ones, and the same was true of the washers, the difference, seemingly, being due to the greater degree of readiness with which the sand was carried from beneath the heads. A shaft was sunk (The Heywood) in the Albany and Boston conglomerate lode, to intersect the cross-cut that had been driven through it, and the new shaft house was provided with an engine for hoisting and pumping.

Up to the close of 1866 there had been paid in dividends the amount of $380,000. The Franklin Company was working on the same vein, directly north of the Pewabic boundary, and the Quincy, on the same vein, on the western boundary, so that the mine on the Pewabic property was rapidly converging, between the section lines, towards the northwest corner of the section, which limit it was constantly approaching, and beneath which corner it must ultimately terminate. Consequently the directors were naturally anxious to discover profitable ground on some of the other veins which crossed the property, and explorations and cross-cuts were made with this vein; but all such effort proved of no avail, and the explorations were finally abandoned.

In 1867 there was an accumulated indebtedness of $136,466.58, and the market price of the copper was less than it cost the company to produce it, so that the directors decided to suspend operations, and to levy an assessment of $3 per share to pay off the debts. But a rise in the price of copper occurring, the determination to stop work was not carried out. A reduction of 25 per cent in the price of labor was made, and an additional assessment of $2.50 per share was made in December of that year. The stockholders received a stock dividend of 61 shares on the Portage Lake and River Improvement Company, and a cash dividend of $18 per share was also declared by the Improvement Company.

In 1869 the yield per fathom was 312 pounds of refined copper, there being 3,079 fathoms of ground broken in the mine. The number of tons of rock treated, with two Ball's stamps, was 43,199, at a cost of 90.95 cents per ton, against a cost of $1.23 the previous year, which was equivalent to a saving of $13,219.20. The average amount stamped with the four Ball's stamps during the first three years, when the heads were new, *i. e.*, from 1860 to 1863, was 37,852 tons per year, at an average cost of 94.7 cents per ton.

In 1868 the Pewabic and the Concord were consolidated. The product of the years, not given in the previous tables, down to 1869, was:

YEARS.	Pounds of Mineral.	Average Per Cent.	Pounds of Ingot.	Average Price Received.	Net Receipts.
1863	2,167,006	78.07	169,724	33.1⅛	$459,971 17
1864	1,864,712	76.68	1,429,857	46.41	621,624 54
1865	2,387,932	72.50	1,731,415	32.56	382,314 35
1866	1,791,181	75.15	1,346,140	30.54	290,132 75
1867	----------	70.88	1,660,208	25.82	313,745 59
1868	1,367,790	76.30	1,043,523	24.	171,704 29
1869	123,779	78.03	111,333	23.	15,121 19

The Pewabic and Franklin were worked much on the same plan. The majority of the stock in both companies was held by the same persons, and the same agent controlled the affairs of both. Capt. Richard Uren was the agent from 1864 to 1868, and during this period he introduced the skip dump in the mines, and also first brought into use the power drill in mining work.

The product ran down from the year 1868; the assets only exceeded the liabilities by $33,000, and it was voted to suspend work on company account in 1870. The Pewabic leased the Franklin mine, and both mines were let to Capt. Uren on tribute for four years, he paying the company a royalty of one-seventh of the copper produced; but when copper sold for more than 25 cents per pound, the company was to have one-half the excess above 25 cents.

In 1871 the company paid a dividend of $1 per share, and at the close of the year 1872, there had been paid in dividends $460,000, and in assessments, $225,000.

The mine was becoming rapidly exhausted, having reached the limit of the extension of the bed on the property, and soon the company found itself involved in litigation with the owners of the southeast quarter of section 23, for mining on their land. An annual product continued to be obtained, mainly produced from the upper levels, and the efforts of the company were exerted, also, in the direction of endeavoring to develop the Concord property in case of being obliged to abandon the Pewabic.

It was finally determined by the directors to put a quietus to the vexatious litigation in which they were engaged, and to obtain a new lease of life for the mine by purchasing the quarter section regarding the boundary between which and their own property the dispute had arisen. This property, the southeast quarter of section 23, was owned by Messrs. Edwards and the Brothers Uren, and the purchase was made in October, 1879, the consideration being $275,000. These gentlemen had bought it a few years previous of the Canal Company, for $25,000.

The work of extending the mine into the new ground began in November thereafter, and has since been prosecuted with all vigor and an abundant success. The mining plant has also been enlarged, and made to conform to the increase of underground work. A new trestle work, from the bottom of the incline to the stamp mill, has been built. Previous to the new purchase in November, the underground work for the year had been confined to the bottom of the 24th level, between the Edwards land and the Franklin boundary. The lode on the new purchase has opened from 10 to 30 feet wide, and is gaining rapidly in length with the increase of depth. The mine is now 1,700 feet down in the lode.

The product for 1879 was 415,565 pounds, yielding 80.99 per cent = 336,475 pounds of ingot. There was an average force of 64 men employed. The total receipts were $243,901.21, and the assets were $3,639.19. The number of tons of rock stamped during the year was 7,299, with an average percentage of 2.84.

In the reorganization the number of shares were increased to 40,000, and an assessment of $10,000 per share was made. The Concord was set off as a separate organization, and some work is now being done by the company at that mine. The product is trammed from the rock house in cars drawn by mules, to the head of the incline, four-fifths of a mile, and thence the cars descend the automatic incline to the stamp mill on the shore of the lake. The mill is provided with four Ball's stamps, Collum's washers, and Evans' slime tables. During the past season a new compressor and engine have been procured and erected at the mine. The accompanying longitudinal section will

show the underground workings, and the tables at the end of the volume, the annual product.

The officers are: D. L. Demmon, Secretary and Treasurer, No. 19 Congress street, Boston; Capt. J. Vivian, Superintendent; J. Hay, Mining Captain.

THE FRANKLIN MINING COMPANY.

This near neighbor and intimate associate of the Pewabic was organized April 23, 1857, and commenced active mining operations upon its location, the S. W. ¼ of Sec. 24, T. 55, R. 34, adjoining the Pewabic on the north, in July of the same year. The Pewabic vein, upon which the company began work, was so far developed as to give every encouragement of success. Indeed, the directors were so confident of receiving immediate returns, that they deemed it to be only necessary to levy an assessment of fifty cents per share—$10,000—with which to open the mine, secure the necessary plant, erect the buildings, etc.; and they were so far justified in their estimate, that for the first two years no further calls were made on the stock. During this period 99⅔ tons of mineral were produced, yielding 60 per cent = 119,803 pounds of ingot, which netted the sum of $23,522.48; but an indebtedness was incurred amounting to $17,000. Accordingly, an assessment of $2 per share was made to liquidate the debts, and to secure the funds for mining operations on an enlarged scale. Additional lands were purchased, consisting of 53 acres off the west side of the S. E. ¼ Sec. 25, giving access to the lake for stamp mill, adjacent to the Pewabic mill; also the quarter sections in Sec. 11, and the S. E. ¼ Sec. 19, thus making the company's estate 850 acres, all in T. 55, R. 34.

A stamp mill was erected and furnished with two heads of Ball's stamps, with washing apparatus, etc., which was completed in 1860; also a double track, inclined-gravity railroad was built from the stamp mill to the top of the bluff, and thence the track was extended to the mine, a distance of 7,000 feet, which, together with the subsequent kiln and other branches, made up a total length of track of 10,000 feet. The ascending cars, which were drawn up by the descending ones loaded with rock, were made to carry up the supplies, etc., from the dock on the lake—a convenience and saving in transportation. The whole length of vein of the property was 3,000 feet, in which, up to December 31, 1861, there had been opened a total number of fathoms of vein of 7,034, and the yield of copper per fathom had been 571 pounds. Six shafts had been sunk, only two of which extended below the third level. The company were employing, at this time, 220 men. The copper produced during each year for the period to 1861 was:

YEARS.	Pounds—Gross.	Per Cent of Copper.	Pounds Refined Copper.	Price Sold for.
1857	10,002	67	6,699	$0 24½
1858	189,885	59	113,104	0 24
1859	409,347	57	234,211	0 22½
1860	738,163	64⅞	484,196	0 21
1861	1,736,401	80¾	1,402,078	0 19½

The whole average cost for smelting, commission, insurance, State tax, etc., was 14 per cent of the amount received for the copper. During the three years

from June 1857 to 1860, the total expenditures aggregated upwards of $517,000, of which $125,000 had been derived from the sales of copper. The mine, in 1861, showed an increased yield, but the low price for copper, which prevailed, did not make the financial result as favorable as was anticipated; still the company's indebtedness was decreased $69,000.

The engines having become inadequate from want of power to do the work of hoisting and pumping, it was found necessary to support them by a large stationary engine, of sufficient capacity to suffice for some years to come. The company had thus far invested in improvements and in personal property the sum of $330,000.

The breaking out of the war took from the region many skillful men that could be illy spared, occasioning an increase of wages, combined with a low price of copper, tended to the embarrassment of the Franklin as of other mining companies, which could only be met by the exercise of the strictest economy, and all work that could be dispensed with was necessarily deferred, and the labor turned in the direction which seemed to promise the most immediate results. But little stoping had been done below the third level, and the appearance of the lode at the extreme depth which had been attained was deemed to be as favorable as at any point which had been mined.

The product for 1862 was greater than that of the preceding year, being 156,580 pounds of ingot; but in 1863 there was a diminution in the yield, arising from a pinch in the vein, similar to what had been before observed in the Quincy and in the Pewabic mines. But still, the high price which the copper brought in the market, enabled the company to accumulate a surplus out of which to pay its first dividend of $3 per share, which was declared in August, 1863. The product for that year was 1,680,189 pounds, yielding 76 per cent = 1,278,684 pounds ingot. It was decided by the company to set off the S. E. ¼ Sec. 19, which had been sufficiently explored to determine the occurrence of metalliferous veins crossing it, and to organize a company to work it. The Concord Mining Company was thus formed, and the stock distributed *pro rata* among the stockholders of the Franklin; but subsequently the stock of the Concord passed into the hands of the owners of the Pewabic. The cost of the real estate and the improvements amounted to $381,000. The product for 1864 was 1,563,869 pounds, yielding 77.5 per cent = 1,211,235 pounds of ingot copper, which sold at an average price of 47¼ cents per pound, affording a sufficient surplus from which to pay the second dividend—$5 per share—which was declared in August, 1864, and a third dividend was declared in April of the same year, of $3 per share.

In the winter of 1863-64 an association of the mining companies was formed to secure immigration from Northern Europe. Participation in this scheme cost the Franklin Company $9,000, but the result was not so encouraging as to warrant further effort in that direction. About 400 men were thus brought into the country. Their arrival had a tendency to prevent apprehended strikes, and many of them were got to enlist in the army and thus helped fill the quota and prevented miners from fleeing to Canada to escape the draft which they so much dreaded.

Mr. J. H. Foster, who had been the agent for six years, resigned in 1864, and his place was filled by the promotion of the mining captain, John P. Hodgson, to the agency.

Two of the Ball's mortars were purchased of the Pewabic; this became necessary from the insufficiency of those that were in use to work up the stamp rock produced. The company also purchased 919 acres of woodland available to

its use, at a cost of a little over $5,000. A locomotive had been previously put on the railroad to run from the mine to the head of the incline.

The product for 1865 was 2,125,589 pounds, yielding 73.37 per cent = 1,559,481 pounds of ingot copper. During this, and the following year, the railroad to the head of the incline was rebuilt, and the directors purchased from the Pewabic company all their interest property which had heretofore been held in common.

The copper produced in 1866 was 2,144,174 pounds, yielding 76.1 per cent =1,638,994 pounds ingot, which sold for an average price of 29.9 cents per pound, giving a net profit above the cost of production of $5,730.97. But the liabilities at the end of the year were $48,625.45. The number of tons of rock stamped, etc., was 57,196, averaging 227 tons per day of running time, which was done at an average cost of $1.25 per ton of rock. In 1865 the average cost of treating the rock was $1.69 per ton. The number of acres of land under cultivation was 115. The total expenditures for the year were $268,914.99. The average number of miners for the year was 192; average wages paid $50.94 per month. Number of other employes 95; their average wages $49.75. The average yield of the rock stamped 1.17 per cent of mineral. In 1867 a change in the management was effected, and it was found that there had been an over-issue of stock by the former officers of 3,874 shares. The stock was all replaced and a judgment obtained against the former president of the company, John Leighton, for $10,168.08. The prospects of the mine were unfavorable. There was a constant falling off in the yield. The average product was only 15 pounds to the ton of rock stamped in 1867, and the stamped rock was 57 per cent of the rock taken from the mine. At this time the cost of production was excessive and the market value of the product less than ever before. The agent at this time, 1863, was Richard Uren. But at the close of the year the vein recovered its former productiveness, and all apprehensions of the permanent failure of the mine were dispelled.

The total product of the year was 1,942,123 pounds of mineral, yielding 72.57 per cent =1,402,455 pounds of ingot, which sold at an average of 23½ cents per pound. Some improvements were made; new boilers were added to the stamp mill, and Ball's washers were thrown out and Collum's substituted.

Number of tons of rock raised from the mine, 90,300; number of tons stamped, 51,356; number of tons of rock stamped per day, 180; average cost for treating per ton, $1.24¾; cost per foot for sinking, $17.79; drifting, $13.60; stoping per fathom, $21.22. It was announced at the close of 1867 that the mine had never been in such excellent condition for profitable working as at that time.

This promising outlook was verified in the succeeding year of 1868, the yield being 337½ pounds of ingot per fathom of ground, against 279½ pounds for the previous year, making a cash difference on the amount of ground stoped, of $50,460. There was 24,000 pounds less of mineral obtained, but the higher percentage which it yielded gave 65,000 pounds of refined copper in excess of previous year. The total product for the year was, 1,463,580 pounds of ingot, which sold for 23.7 cents per pound. A committee was appointed to thoroughly examine and report upon the property. The profits of the year were $32,000, the most of which sum was expended on the stamp mill.

The total amount of rock treated, up to and including 1868, was 299,088 tons, an average of 42,727 tons per year. The number of tons treated in 1868 was 43,028; number of tons raised from the mine was 79,880; number of pounds of mineral produced, 594 1915-2000 tons; average number of tons

stamped per day, 167; cost per ton for treating, $1.31; number of men employed, 338. The liabilities of the company were reduced from the sum of $107.628.40 to $67,514.74, and an excess of assets over liabilities was claimed of $58,085.79. Failing in their efforts to borrow money on mining security, an assessment was laid of $2.50 per share. There had now been made assessments amounting to $320,000.

In 1870 the mine was leased to the agents of the Pewabic, on tribute, and during the next four years dividends, in all, of $3 per share, were declared from the receipts from the royalty. The total receipts up to the close of 1874 were $3,600,000, and the total dividends paid were $280,000; assessments, $320,000.

The lease having expired in 1874, the company again resumed work. The affairs of the company had reached a crisis where something must be done. The mine had been practically exhausted in the upper levels, which had been opened. The houses and mining plant were in somewhat of a dilapidated condition. The new management determined to rescue the property from the absolute ruin that seemed impending. A rigorous policy was decided upon, and pursued with such effect that in one year the market value of the stock was enhanced six fold, and the location was changed into a scene of thrift and activity. The mine had been leased when it should have been systematically worked, and only when the stockholders took the matter determinedly in hand was the mine brought back to renewed life.

The product in 1875 was 749 tons, 120 pounds, yielding 1,167,633 pounds of ingot. The receipts were $263,288.66, and the cash in hand was $10,000.

In 1876 the product was 1,206 tons, 487 pounds of mineral. A new dock was built on the lake, 175 feet long, and 20 feet wide. $150,000 were expended up to the close of the year in improvements.

The mine produced in 1877 1,436 tons, 162 pounds of mineral. In 1878 the product was 3,162,040 pounds, yielding 82.181 per cent = 2,599,073 pounds of ingot. The number of tons of rock mined was 133,163; number of tons hoisted was 121,357. The number of tons treated in the mill was 96,358; number of tons rejected was 24,999. The average cost of breaking and delivering, etc., to the stamp mill, to ton of rock, was 16.13 cents; average cost of stamping and washing per ton was 68 cents; average number of tons stamped per cord of wood, 10.58.

Up to January 1, 1880, there had been expended during the preceding five years, in repairs, machinery, etc., over $200,000, all of which had been paid by the earnings of the mine, and no assessment had been called for. They had started with an empty treasury and everything out of repair, and the earnings of the mine had been made to meet all the demands for expenditure, so that on the beginning of 1880 the company was out of debt, and a small balance in the treasury—$1,655.76.

During the year 110,209 tons of rock were treated in the stamp mill, at a cost of 52 cents per ton, which includes every item of expense connected therewith. Two new locomotive boilers were put in the stamp mill, and their operation was found to effect a saving in fuel of 15 per cent; 350 feet of shafts were sunk, 574 feet of winzes, and 2,410 feet of drifting done; total amount of ground broken was 8,550 fathoms; number of tons of rock hoisted to the surface was 141,714, 20 per cent of which was rejected. The total cost of manipulating a ton of rock was $2.37, a saving of 34 cents over the previous year. Capt. Thomas Dennis was appointed mining captain. The average cost of breaking rock is shown in the following table:

YEARS.	Cost of Selecting and Breaking Rock.	Cost of Stamping Per Ton.	Total Expense of Manipulating Per Ton.
1876	$0 20	$0 81	$3 45
1877	0 17	0 71	3 03
1878	0 13	0 68	2 71
1879	0 12	0 52	2 34

Making a difference of $1.08 per ton in favor of 1879, as compared to 1876, or a total saving of $53,051.12, in manipulating the year's product—141,714 tons.

The mine lacks a good deal of having reached the depth attained by the Pewabic. The surface improvements are good, lacking mainly in a rock house. The breaking is now done in No. 5 shaft house, in which are a screen and two Blake's crushers. The distance to incline—length of locomotive haul—is 4,300 feet. Product of 1880, up to December 1, is 2,876,519 pounds of mineral, yielding 82.76 per cent.

THE ALBANY AND BOSTON MINING COMPANY.

This company was organized under the general mining laws of the State in June, 1860. The company held the greater portions of Secs. 7 and 8, T. 55, R. 33, and began work in the same year of its organization on an amygdaloid belt, in which several shafts were sunk to the first level, and 800 feet of galleries made, but the vein not proving of sufficient promise, operations in it were abandoned, and in 1864 resumed in the belt known as the Albany and Boston Conglomerate. The amygdaloid lies between two parallel belts which cross the property, at a distance apart of about 625 feet. These belts have a bearing of about N. 40° E., and a northwesterly dip of 52° to 56° with the horizon. The Conglomerate is a wide belt, attaining to 32 feet in width; in character it is hard and compact, made up of boulders and pebbles of reddish feldspathic rock, cemented together with a matrix composed of the same materials in which the copper is disseminated in particles and small masses. The lode has a length on the property of nearly one mile, and is underlaid by a belt of sandstone of about six feet in thickness, which rests on a bed of amygdaloid trap. The mining shafts and galleries were made in the sandstone having the copper bearing vein above for stoping. Some 50 tons of this vein rock were treated at the Huron mill, and gave a yield of 4 per cent, which extraordinary result greatly excited the hopes of the stockholders, and induced the agent of the Pewabic to cross-cut to intersect the lode on that property. The main shaft was carried down 250 feet to the third level, and a total drifting done on the three levels of 1,200 feet before stoping of any amount was begun. Thirty-three dwellings, a warehouse, store, engine house, boiler house, saw-mill, etc., were built. A hoisting engine, pumping engine, winding machinery, stamp mill, with 24 heads of Gates' stamps, were erected in 1865. The mill was placed on a small stream which crosses the property.

But the high expectation that the lode would average three or four per cent of ingot copper was not realized; on the contrary, the result for the year 1866 was only 1.3 per cent. The 50 tons smelted at the Huron mill the year before, yielding 4 per cent of ingot, and some experiments reported by the agent in smelting the rock without stamping, producing 8 to 13 per cent of ingot, when

contrasted with the actual result of the subsequent work was greatly disappointing, and showed that the vein was only rich in places. The expenses for the year 1866 were $254,022.54, and the receipts from the sales of copper—271,200 pounds of ingot—were $75,445.85. The total expenditures to August, 1866, were $978,002.44, of which sum $840,000 had been met by assessments on the capital stock.

The company launched out far too largely in surface improvements and mining plant before thoroughly proving the mine. Great expenditure was incurred in advance that should have been avoided until it was certainly determined that there was plenty of copper, and in waiting for that fact to appear, the money would probably have been saved. The heavy disbursements were made on the assumption that they had a paying vein, and were made on a scale for producing and marketing a large product. The company continued to work until 1869, when operations were suspended, and only a small amount of tribute work has since been done. The total product of the mine is about 440 tons of refined copper. Until recently the company derived a small income from the rent of its stamp mill. The mill, however, was, about three years ago, destroyed by fire.

THE MESNARD MINING COMPANY.

This company was organized in 1862, immediately upon the discovery of a mass of copper, of 18 tons weight, upon the property. The mass had been moved a distance of 48 feet from its original bed by the ancient miners, the evidences of whose work were plentifully apparent in the multitude of stone hammers, etc., that were found surrounding the mass, and in the place where it had apparently been taken. The bed from which the mass was derived had become filled up with dirt and decayed bones, and the mass itself was buried beneath the earth that had accumulated over it. Trees corresponding in size with those of the surrounding forest were growing over it.

The mine was opened in the epidote vein, from which this mass had come, and great hopes were entertained of results, which several years of mining work failed to realize. Less than 50 tons, all told, were obtained, and unable to find copper in paying quantity, work was suspended.

The location consists of 160 acres, being the N. E. $\frac{1}{4}$ of Sec. 24, T. 55, R. 33. Some tribute work was done on the property after the company ceased operations, and in 1876 it passed into the possession of the owners of the Pewabic, etc., with D. L. Demmon, Secretary and Treasurer; office, Boston, Mass.

THE PONTIAC MINE,

lying adjacent on the north, being the S. E. $\frac{1}{4}$ Sec. 13, was worked at the same time as the above, but with no noticeable result. The property is owned by the same parties.

THE DOUGLASS MINING COMPANY.

Douglass Mining Company, owning the N. E. $\frac{1}{4}$ Sec. 30, and N. W. $\frac{1}{4}$ Sec. 29, T. 55, R. 33, is situated about one mile north from Portage lake. The company was organized in 1863, and began work in the same year by sinking four shafts to the first level in the Isle Royal lode. The work was under the superintendence of J. H. Forster, and was continued until 1868, resulting in obtaining a total product of about 85 tons of refined copper.

THE HIGHLAND MINING COMPANY.

This location adjoins the Douglass on the south and west, and a small amount of work was done at the same period, as indicated in the preceding notice. Next to the Douglass is situated the Concord, of which mention has been made in the history of the Pewabic and Franklin Companies, and in succession also are the locations called the Arcadian, and the Edwards Companies, which were organized to work the northerly extension of the Isle Royal and the Grand Portage lodes. But with the exception of the Concord, all are now idle, and none have heretofore done very much work.

THE DORCHESTER MINING

locations, consisting of the N. W. $\frac{1}{4}$ of the S. E. $\frac{1}{4}$, and the S. $\frac{1}{2}$ of the S. W. $\frac{1}{4}$ of Sec. 18, T. 55, R. 33, was explored in 1863, and a little mining work done on the Mesnard or Epidote lode, which has a length on the property of 1,600 feet, and showed a width of three feet. Several other amygdaloid or conglomerate belts cross the property.

ST. MARY'S COPPER MINING COMPANY.

This company was also organized in 1863, and owned the N. $\frac{1}{2}$ of Sec. 18, T. 55, R. 33, being about three miles north of Hancock. The great success which attended the Quincy, Pewabic, and Franklin mines, led to the organization of several companies, for the purpose of working the extension of the Pewabic lode on the lands which it crossed to the north. Among them was the St. Mary's, which began work in 1863 by sinking three shafts to the depth, respectively, of 50 feet, 75 feet, and 100 feet, in the Mesnard epidote vein, which lode also crosses the property, and was thought, then, to be a very promising one. A small amount of copper was taken out, in value about $1,400, and an assessment was made of $50,000, which was expended on surface improvements and mining work. The corporators were Boston gentlemen. Fred. Beck, Secretary and Treasurer, Boston, Mass.

HANCOCK MINING COMPANY.

This company was organized in 1859 under the general mining laws of the State, with a capital stock of $500,000. The location comprises the S. W. $\frac{1}{4}$ of Sec. 26, T. 55, R. 34. The mine was opened in the side of the high bluff which rises from the side of Portage lake, and is but a short distance northwest from the village of Hancock. The mine was opened by an adit driven into the bluff from the south, at a point 218 feet above Portage lake to intersect a shaft lowered from the surface of the hill 100 feet above. A second adit was subsequently driven on a level 70 feet below the first, and from the intersection with the surface an incline was constructed to the stamp mill, which was built on the lake, a distance from the mine of 1,400 feet, the product coming out at the adit, which also afforded the requisite drainage. The stamp mill built in 1860 was intended for 32 heads, but was only furnished with 16 heads, similar to the Quincy stamps.

The office of the company, originally in New York, was, in 1861, removed to Boston on a change of the board of directors, and Horatio Bigelow became secretary and treasurer.

During the succeeding three or four years the operations of the company

were considerably enlarged. The main shaft was fitted for hoisting and pumping, and provided with hoisting engine, pumping engine, boilers placed in suitable buildings, also engine house and shaft house built at Dupeer's shaft. The stamp mill was overhauled, a new boiler house and new engine house built, and 40 heads of stamps provided. Many other buildings were constructed, incurring, all told, an expenditure of $122,625. The total expenditures up to this date, January 1, 1865, had been $350,059.55; $248,395 had been paid in in assessments, and $104,120.98 had been received from the sales of copper. The product for the year 1864 was 100,182 pounds, yielding 61,044 pounds of refined copper. The ground yielded 446 pounds per fathom.

The company continued to work with poor success until the capital stock had been exhausted; the mine was leased on tribute until about 1872, when it was sold to Captain Snell and W. H. Streeter, who, in 1873, changed the name to the Sumner Mining Company; but little, however, was done until the winter of 1879–80, when the property was bought by Mr. Ed. Ryan, of Hancock, Mich., who reorganized the concern under the general mining laws of the State, as the Hancock Copper Mining Company, with a capital stock of $100,000, divided into 40,000 shares, and work was begun in the month of June last by the new company. The stamp mill has been rebuilt and supplied with two heads Ball's stamps, and with Collum's washers, and thus has an estimated capacity of 160 tons in 24 hours. The incline from the mine to the mill has been repaired and put in working order; the mine has been unwatered, and mining work is regularly progressing. The belt is an amygdaloid, having a width of about four feet, and bearing N. 36° E., and dipping to the northwest at an angle of 56°. The product, at present, comes out at the adit, and is sent in cars down the incline to the mill, 1,400 feet distant. The adit is about 240 feet in depth below the surface at the north end, and is 1,400 feet in length. The mine is down to the 80th level, and has an extreme depth of 640 feet, and the new company has already sunk 100 feet below the former bottom level, and has expended, in improvements, repairs, etc., $100,000. The rock yields about two per cent of copper. The diamond drill is being used in the work of exploration in the mine. The sinking is costing about $23 per foot, and the stoping from $6 to $12 per fathom. The stamp mill was started up the 13th of December, 1880. The rock house, with breakers, etc., is connected with the stamp mill. The company employs 100 miners—has 140 men in all. The wages of the miners are $47 per month, and of other laborers the average is $38.50. The stock is held in Hancock, Chicago, Milwaukee, and Cleveland.

The officers are: Ed. Ryan, President; August Mette, Secretary and Treasurer; office, Hancock, Mich.

TECUMSEH MINING COMPANY.

The Tecumseh Mining Company was organized in March, 1880, and owns 480 acres of land, lying southwest from the Osceola and adjoining it. The property comprises the S. E. $\frac{1}{4}$ of S. E. $\frac{1}{4}$ of Sec. 27, the N. $\frac{1}{2}$ of the N. E. $\frac{1}{4}$ and the E. $\frac{1}{2}$ of the N. W. $\frac{1}{4}$ and the S. W. $\frac{1}{4}$ of the N. W. $\frac{1}{4}$ of Sec. 34, and the S. $\frac{1}{2}$ of the N. $\frac{1}{2}$ of Sec. 33, and the S. $\frac{1}{2}$ of the N. E. $\frac{1}{4}$ of Sec. 32, all in T. 56, R. 33. The location extends one and one-half miles east and west, and is crossed in the east part by the Calumet conglomerate and the Osceola amygdaloid, and also by the track of the Mineral Range railroad. Other important lodes undoubtedly cross the property, but the great depth of drift materials

with which the rock is covered, renders it difficult to locate the copper bearing belts. Two shafts have been started; one to reach the Calumet conglomerate, and the other the Osceola amygdaloid. These bear N. 39° E., and dip northwesterly 40°. The conglomerate shaft, it is calculated, will be at the point of entering the rock, 550 feet from the boundary line and will have a downward extent within the limits of the property on the course of the vein, of 720 feet. It was sunk vertically 70 feet through the drift to the surface of the trap, and thence drifting east a distance of 50 feet, disclosed the vein. The vertical shaft is now being carried down 40 feet through the rock, when it is calculated the vein will be intersected. No. 4, the amygdaloid shaft, is 1,600 feet to the south of the one above described, and was sunk 64 feet through the drift and 9 feet through the rock to the lode, and thence the sinking was extended in the lode 35 feet, and a horizontal cross-cut of 12 feet through it. The hanging wall is a fine hard trap; the foot wall a coarse trap. The improvements, thus far, consist of a few dwelling houses, and a 40-horse power engine has recently been procured to pump and hoist with. Mr. Charles H. Palmer, Jr., a mining engineer of much experience, has recently assumed charge of the mining operations, and it is safe to assume that in future whatever work it may be decided to do will be efficiently performed.

THE OSCEOLA CONSOLIDATED MINING COMPANY.

The Osceola was organized in 1873. Its advent into existence was heralded far and wide, and the stock was eagerly sought for on the basis of the statement that Mr. E. H. Hurlburt, who had been credited with the discovery of the Calumet & Hecla lode, had found another conglomerate belt of surpassing richness. The mine was opened by Mr. Hurlburt, through whose influence and reputation the organization was made and the capital secured. It was supposed that the company was formed to work a conglomerate lode other than the southerly extension of the Calumet & Hecla, which was no new discovery. But the borings and explorations, which were made to find the original resting place of the conglomerate boulders which had been found on the surface, failed of success. It was quite well known that certain erratic masses of conglomerate, rich in copper, had been found in this locality, of a character, it was thought, somewhat different from the Calumet & Hecla conglomerate; and also the position in which they occurred did not correspond with the drift from the Calumet lode, so that it was assumed they were derived from an independent lode. The conjectured mineral belt, it was rumored, had been discovered, and was thus the basis of the new organization, a belief which enabled the projectors to readily place the shares at unusually favorable rates for new stock. When it became known that the mine was being opened on the Calumet vein, there was among those interested, whose expectations had been a good deal raised, a feeling of disappointment. Public anticipation did not, however, wholly subside until it became certain that there had been no previous discovery, and that the exploration carried contemporaneously with the mining work failed to develop anything of value. But money enough was obtained to equip the mine fully at the start. A large amount of surface improvement was made. All the houses necessary up to the present time were built.

The mine opened in the Calumet & Hecla vein proved to be so favorable, at first, that whatever else might have been expected, there seemed to be, after all, every reason for congratulation, until further development denoted its ultimate

failure; in fact, that the company possessed in this belt but a short extent of profitable ground. Near the Calumet and Hecla line the vein corresponded in texture and in richness to its known character in the lands of its celebrated neighbor, but further to south the vein becomes soft, friable and worthless. The productive ground must soon be exhausted, and then in the apparent condition of facts, the existence of the company must terminate. In this emergency a most fortunate discovery was made of an amygdaloid belt, 800 feet to the east, and it was determined to prove this bed and ascertain its value, so that, if favorable, mining operations could be transferred to it, prior to the failure of the mine already opened in the conglomerate. This work was begun in 1877, and now the company have sunk in this deposit four shafts down to the respective depths of 600 feet, 400 feet, 400 feet, and 100 feet. The second level is drifted 1,850 feet, the third 1,200 feet, the fourth 600 feet. The distance between the extreme points of openings is 4,000 feet; 3,000 feet of levels have been driven in this belt the present year, and the whole is developing with a degree of uniformity and richness that the success and prosperity of the mine seems entirely assured.

The vein bears north 39° E., and dips to the northwest 40°, and has a width of from 3 feet to 30 feet. In all there are six shafts started. The workings are on the west part of Sec. 26 and N. ½ Sec. 27, T. 55, R. 33, which was formerly the Sewabic mine. The combining of the two companies occurred at the time of the organization. In 1879 a further consolidation took place with the Opechee, which latter held the S. ½ of Sec. 27 and the west part of Sec. 26. The Opechee was originally a part of the company's property. The company also own Sec. 24 and the remainder of Sec. 26, which was organized as the Laurium Mining Company.

The known veins crossing the property are, the most westerly, Allouez conglomerate, next east the Calumet conglomerate, the Osceola amygdaloid, the Kearsage conglomerate, Kearsage amygdaloid. On the Laurium, are the two latter lodes, one the Isle Royal; but only a small amount of exploration had been done on them.

The company has only been at work in the amygdaloid for two years; the first year and a half were spent in finding out what they had. The shafts are sunk at an angle of 40° and are sometimes in the foot wall and sometimes in the hanging wall.

There are three large rock houses; one on the conglomerate and two on the amygdaloid. In the latter mine, a rock house is built on the east side of No. 1 shaft, so that the skip cars run up directly from the shaft into it, and the rock from No. 2 shaft is also run to it on an elevated railway. The building, as are the other rock houses, is entered by two tracks for filling the cars from two rows of shutes, one on each side of the building; these tracks connect with the main line of the Mineral Range railroad, over which the rock is taken to the stamp mill on Portage lake, near Hancock, 11 miles distant. The rock house at No. 4 shaft was built the past season, and is not yet entirely completed although in use. At present only the rock from No. 3 shaft is dumped into it. The cars from No. 3 run on a trestle 50 feet in height, and are drawn to and from the building by wire rope running over drums; 120 tons per day are run from No. 3 to this rock house, and are there handled by three men. The cars dump upon a large coarse bar screen, which carries the heavy pieces to the floor and allows all the smaller stuff to fall through upon a gabled shape screen slanting either way at right angles to the direction of the upper one. By this double screening arrangement the material is separated for economical hand-

ling. The large pieces are by themselves, to be thrown into the heavy Blake's crushers. The smaller portions carried to the floor down the under screens, are broken in the medium sized crushers, and all the fine particles pass through the screens directly into the rock bins below, as do also the broken materials from the crushers. The large breakers are 15x24 inches, and there are two smaller ones. When the other shaft is used there will be like arrangements on the same floor for that also. In all there are seven small or medium sized breakers in use in the several rock houses. The new building is 50x90 feet, and is entered by the elevated track at a height of 50 feet above the ground. The bins have a capacity of 2,500 tons of rock. The entire structure with its appurtenances, elevated track, engine and engine-house, etc., cost $70,000. The company own the cars in which the rock is conveyed to the stamp mill, and the railroad company charges 37½ cents per ton for hauling a distance of 11 miles. The Osceola also put in and cares for the side tracks, etc.

The rock house on the conglomerate belt is furnished with a hammer which will be soon transferred to No. 4 rock house.

There are two hoisting engines on the amygdaloid and one on the conglomerate; two pumping engines and two compressors. The company operate 15 Rand's drills; four men and two boys to each drill. In fact, the underground work is done as far as possible with machinery. Capt. Daniels, the efficient agent of the mine, states that he finds a saving of expense of 40 per cent in stoping by use of power drills and 20 per cent in drifting.

The stamp mill is one of the most complete on the lake, and is furnished with the latest and most approved mechanical appliances for separating the the copper from the rock. It is provided with three Ball's stamps, 15 inch cylinders, 54 Collum's washers and five Evans' slime tables, and they are now treating at the mill 450 tons per day. The cost of the mill was about $125,000. The heads of the stamp are covered by chilled iron shoes, weighing upwards of 600 pounds each, and in running on the conglomerate rock they wear down one-sided, so as to be useless in three or four days.

The original mine, as before stated, was opened on the conglomerate. Six shafts were sunk. No. 1, 600 feet south of Hecla line, is the only one that has proved of any value. This shaft dips with the lode at an angle of about 45°, and at a depth of 1,000 feet reaches the boundary of the company's property. To this limit the workings have already nearly attained. No. 2 shaft was sunk to a depth of 300 feet, and No. 3 to 900 feet. Both have been abandoned, as they yielded no copper; but on the product from No. 1 the company were able for a few years to make an excellent showing. Mining was begun in the fall of 1873, and in the following year the company shipped 629 tons of mineral= 468 tons of ingot copper. In 1875 the product was 665 tons 303 pounds; in 1876, 2,405,631 pounds, yielding 70 40-100 per cent=1,693,737 pounds of ingot copper, which sold at 20 56-100 cents per pound=$348,333.25; silver obtained, 8,475.80=$349,189.87. The expenses were $298,087.56; profit, $51,-093.27. An assessment of $2.00 per share was made. Up to this time the company had leased the Albany and Boston stamp-mill, at which mill its rock was treated, but in November of that year the Osceola mill was started. In 1877 the ingot product was 1,382 tons 777 pounds, and in 1878 the product was 3,316,725 pounds, yielding 79 178-1000 per cent=2,626,120 pounds of ingot. In addition was obtained a low grade of mineral, got by washing the sands—603,595 pounds, yielding 13 33-100 per cent=79,878 pounds of ingot, thus making a total production of 2,705,998 pounds of refined copper, which

sold for $420,340.14; silver sold for $5,525.61=$425,865.75 for the total year's earnings. Total expenses, $338,481.78, leaving a profit of $87,383.97. A dividend of $1.00 per share was paid. The company met with the loss of a rock house, destroyed by fire. The yield of ingot per fathom was 57.3 pounds; 341 fathoms were broken on the amygdaloid; 79,439 tons of rock were treated at the stamp mill at a cost of 62 46-100 cents per ton. In 1879 the product of the mine in mineral was 3,764,444 pounds, yielding 83 38-100 per cent= 3,138,828 pounds of refined copper. In addition the copper obtained from the sand washings amounted to 368,335 pounds, which smelted yielded 14 642-1000 per cent or 53,935 pounds of ingot. The tribute washings were 4,624 pounds, making in all 3,197,387 pounds of ingot, which sold for an average price of 17 786-1000 cents per pound, which sold for, including silver, $573,588.25. Total expenses were $375,834.54, leaving for profit $197,753.71. A dividend, payable February, 1880, was declared of $1.00 per share.

No. of tons of rock stamped, 95,055, which cost, including mining, hoisting, tramming, stamping, washing, and every other expense connected therewith, $3.20 82-100 per ton. The cost of treating at the mill was 51.02 cents per ton; cost of transporting rock from mine to mill, 37½ cents; breaking, etc., 17 cents; office and other surface expenses, 12.12 cents per ton.

Number of tons of conglomerate rock hoisted, 64,052; discarded, 5,452 tons; sent to mill, 58,600 tons. Number of tons of amygdaloid, 44,506; number of tons sent to mill, 36,455; number of tons stamped and washed per cord of wood consumed, 15½.

The number of tons of rock treated in 1880 was 107,530, yielding 3,971,319 of 85 per cent of ingot—the highest per centage obtained by any company on the lake. Some months the product yields 87 per cent of ingot. The number of men employed during the year, 420, of whom 120 were miners. The tailings are worked on company account, and just about enough is obtained to pay the expense of working. The cost per fathom for stoping was $9.00; sinking per foot, $18; drifting, $10. The number of tons raised from the amygdaloid during the year 1880 is 75,000; number of tons rejected, 7,000. The timber work in the mine costs about 25 cents per ton. More labor and money have been expended in opening during the year than in stoping.

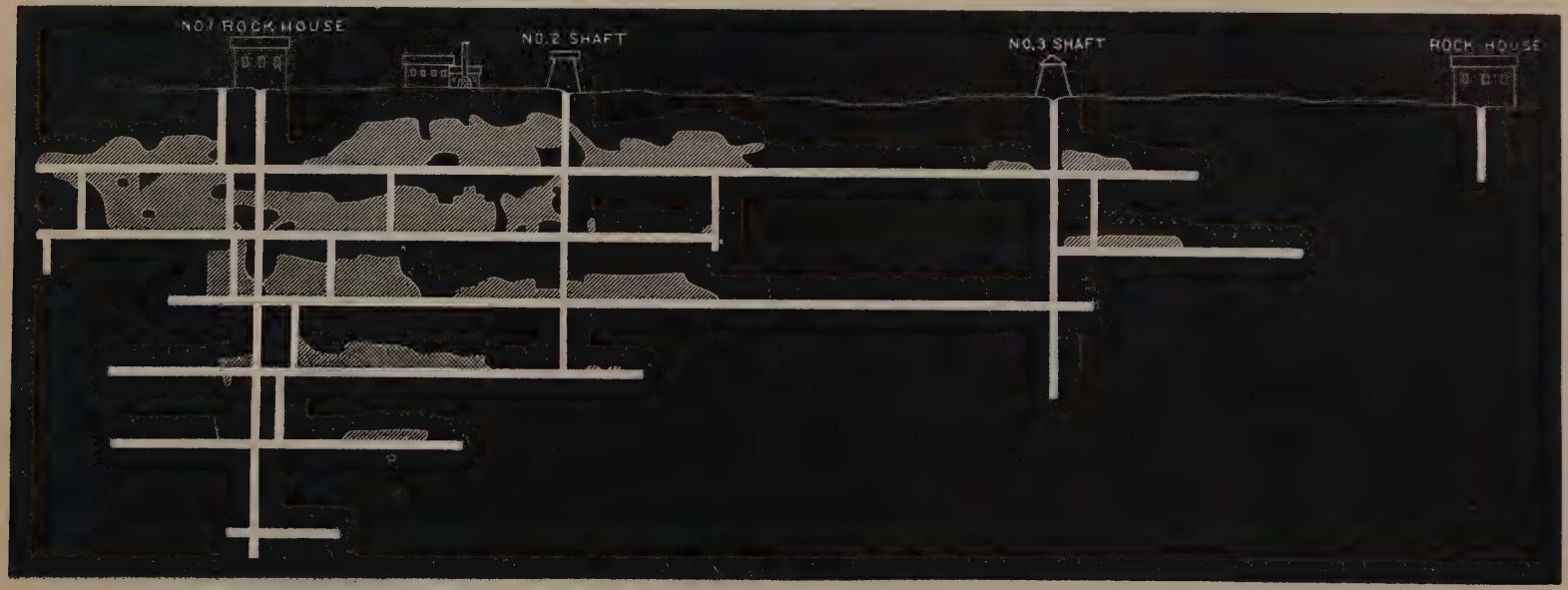
The cost of treating the rock is less than for any previous years, but the exact figures cannot be given, as the details are not all made up. The amygdaloid yields somewhat less than two per cent of ingot copper. In character the lode is similar to the Pewabic.

In February last the previously-mentioned consolidation was made with the Opechee, which joins the Osceola on the south. The Opechee estate comprised 400 acres, and carries across it several important lodes, including the Calumet and Hecla. The consolidation was made on the basis of an exchange of stock —two shares of the Opechee for one share of the Osceola. It is the aim of the company, if the developments shall warrant the outlay, to ultimately increase the output to 1,000 tons of rock per day.

The number of shares is now 50,000, and the latest quotations of the market value per share is $37, thus making the current value of the mine=$1,850,000; capital stock, $1,250,000, and the total amount of dividends paid to date is $460,000. The treasurer's office is No. 178 Devonshire street, Boston, Mass. Joseph D. Clark, President; A. S. Bigelow, Secretary and Treasurer; John Daniels, Agent, Osceola, Mich.

LONGITUDINAL SECTION OF THE OSCEOLA MINE (ON THE AMYGDALOID VEIN), 1881.

Scale, 240 ft. to one inch.



THE CALUMET AND HECLA CONSOLIDATED MINING COMPANY.

Among copper mining companies the Calumet and Hecla stands alone. In all the estimates and consolidations applicable to other mining companies, this company must be excepted. The mine so greatly exceeds all others in extent and richness that there is none to be compared with it in product or in profit. If any comparison is instituted it must be borne in mind that the Calumet and Hecla lode is probably by far the richest vein ever known in the annals of copper mining. Not only is this true, but it is the only mine ever extensively and successfully worked in a conglomerate vein. The Allouez is worked in a conglomerate, but bears no comparison in productive capacity to its neighbor. And so far as yet known this company possesses all of this remarkable deposit that is of any considerable value. On the Osceola, except adjacent to the Hecla boundary, the lode proved worthless, and to the north, on the Schoolcraft location, this company was ruined in its efforts to derive a support from this belt.

With a capital stock of $2,500,000, it is worth in the market upwards of $25,000,000; shares, which have a par value of $25 are worth upwards of $250 in the market, and with only an expenditure of the capital stock of $1,200,000 the mine has returned to the stockholders in dividends the sum of $18,850,000, besides supplying a mining plant and surface improvements superior, it is believed, to that possessed by any other mine in the world.

It is situated in T. 56, R. 33, Secs. 14, 15 and 23, a distance from Lake Superior of about five miles, and from Portage lake of 12 miles, with which it is connected by the Mineral Range Railroad.

At the close of 1865 the stock was held at $1 per share, but speedily thereafter it began to advance, the rise being due to the discovery of the vein, which is said to have been the result of mere accident. But whatever the origin of the discovery, or to whomsoever the credit may be due, it soon became noised abroad, and excitement was the order of the day. The stock by successive upward moves soon reached to $30 per share. An assessment of $5 per share was made to develop the lode, and as the developments made by working the lode bore out all that was anticipated, the value of the shares continued to rise, and in a few brief months reached $75. In the summer of 1866, having a large territory, the company determined to organize a new company, and thus created the Hecla, the stock of which was apportioned to the holders of the Calumet, share for share, at $5 per share, and the sum used for a working capital. But before winter, ere the new mine had been opened, the stock advanced to $75 per share; two additional assessments were made, amounting to $8 per share on the Hecla, and an additional one of $5 on the Calumet, which caused its stock to fall to $15. Other assessments were called in amounting, February, 1868, to $15 per share on the Calumet, and to $25 per share on the Hecla stock. The stock was then selling at $30 per share. The results of the mining operations continuing favorable, the stock of the companies gradually went up as public confidence became secured, so that in December, 1869, the Hecla had advanced to $85, and paid its first dividend of $5 per share, which it has since uniformly repeated at each succeeding quarter, with an occasional extra added.

The Calumet made its first dividend in August, 1870, which it repeated each quarter up to the period of the consolidation of the two companies, in May, 1871. At this date the Hecla had paid $32.50 per share in dividends, and the stock had been assessed $25 per share. The Calumet had paid $15 in divi-

dends and the stock had been assessed $15 per share. The union of the two companies made the capital stock $1,000,000, in 40,000 shares, and a stock dividend increased the number to 50,000, and in 1873 a further increase made the number 80,000. At that date the dividends amounted to $2,800,000. In 1874 there were 230,000 tons of rock treated, and the total cost of the rock per ton was $7.40. In 1875 239,000 tons were stamped, and the cost per ton of rock was $5.82. Only about two per cent of the rock is rejected; it goes directly from the hoist to the stamp mill. With other mines a careful selection is generally necessary, and sometimes 25 per cent and even upwards is rejected. The average of ingot per ton of rock in 1874, was 4.28 per cent; in 1875, 4.33. The product in 1873 in gross tons 10,152 tons, 942 pounds, 80 per cent ingot; 1874, 12,670 tons, 647 pounds mineral; 1875, 13,219 tons, 1,595 pounds.

YEARS.	Product—Gross.	Product—Ingot.	Per Cent.	Assets.	Liabilities.
1875	14,333 tons, 1395 lbs.	10,901 tons, 173 lbs.	77.46	$2,669,873.54	$150,235.31
1876	14,135 tons, 114 lbs.	10,802 tons, 1401 lbs.	76.43	2,763,691.67	133,444.11
1877	15,528 tons, 735 lbs.	11,823 tons, 555 lbs.	76.16	2,648,118.91	180,076.36
1878	16,463 tons, 911 lbs.	12,578 tons, 582 lbs.	76.22	3,877,353.59	462,681.87
1879	18,465 tons, 1616 lbs.	14,277 tons, 1425 lbs.	77.32	----------	----------

The mine is kept open five years ahead. In 1878 the rock in the south end the mine yielded 2½ per cent, against 4½ per cent in the old mine. In 1879 the capital stock was increased to $2,500,000, 100,000 shares, the limit allowed by the laws of this State.

The average bearing of the lode is N. 3° E., and the general dip with the horizon 38° northwesterly. The height above Lake Superior is 640 feet. The lode—conglomerate—is all stamp rock, and the extreme length to which it has been opened on the property is 5,700 feet, 4,200 feet of which is considered first-class ground. The levels are laid out with a base of 60 feet perpendicular, and the lowest is the 24th; distance down, on the lay of the rock, is 2,250 feet. In the Hecla mine are six working shafts, and in the Calumet five. In the south part of the Hecla, adjacent to the Osceola, are two shafts down to the fourth level. The underground work is performed with the aid of compressors, while on the Hecla side are Rand's double, 28x42 inches. Double compressors are being put in at the Calumet mine, 32x48 inch, Rand's. There are now in use in the mines 62 power drills, Rand's pattern, and four Bailey's engines are used for hoisting from the bottom of the shafts to the skip levels. The main air pipe extending down into the mine is from four to one and one-half inches diameter, and the extent of air pipe under ground is 5,400 feet in one continuous line. The number of tons hoisted per day is about 1,000. The main hoisting engine at the Hecla is Leavitt's compound style, having a working capacity of 1,000 horse power; in addition to the hoisting it drives also the double compressor. The power is applied by means of wire rope transmission attached to the winding drums, of which there are four, 25 feet diameter and seven feet face. The cylinders, high pressure, are 23¾ inches diameter, the low pressure 36 inches, with six-foot stroke. At the Calumet the present hoisting power is a 24-inch and 48-inch cylinder compound engine, four-foot stroke, with four drums, 10 feet diameter, 12 feet face. The foundations are laid and a compound Leavitt's engine is being erected at the present time of 4,700 horse power. This engine is designed to run the compressor, hoisting gear, pump and man engine by means of wire rope transmission. The pump

and man engine are located near No. 1 shaft. To provide against accident to hoisting engine, the gearing house is provided with an Allen & Porter engine, ready for any emergency that may possibly occur. The machinery in this new engine is of very heavy pattern, and will probably last for many years to come.

To assist in ventilation in the mine, in summer season, there is a large exhaust fan, 30 feet in diameter, in brick casing of ample size, Guebel's pattern. It is found to answer the purpose admirably, and becomes a necessity in hot weather. It makes 50 revolutions per minute. The exhaust chambers are 8x10 feet.

The rock is transmitted from the shafts to the rock houses in cars running on elevated track, Frue's automatic elevated railroad. The longest run is 1,500 feet. The largest pieces of rock are broken with the steam hammer, having a weight of six tons. The smaller portions are broken in the Blake crushers, of which there are two sizes, 24x18 inch and 10x15 inch. To supply the necessary water for the engines at the mines, extensive water-works have been completed during the past season, located on Calumet creek, at a distance of 4,000 feet to the north from the Calumet hoisting-engine house. The water-works are supplied, at the present time, with a compound Worthington pumping engine, cylinders 12 inch and 24 inch, three and a half foot stroke. It is the intention to substitute for the one now in use, next season, one of Leavitt's compound style. The water is derived from the pond made by damming the creek. The pipe from the water-works to the mine is 16 inch diameter. The hoisting engines are furnished with Stur's friction gear.

The stamp mills are located at Torch lake, five miles distant, and are connected with the mine by a railroad, four-foot gauge, operated with locomotive engines, of which there are three single 30-ton Fairlie engines and one 30-ton common engine. The stamp mills are furnished with six Ball stamps, 15 inch cylinders, and one Ball-Leavitt head now in use, soon to be increased by a second Ball-Leavitt head. The stamp heads make 90 blows per minute, and the shoes last about seven days on an average. From the top of the bluff, at the terminus of the railroad, the cars run to the stamp mills on a gravity incline three-fourths of a mile in length.

The water for the use of the two mills is pumped from the lake by a compound Leavitt's pumping engine throwing 9,000,000 gallons each 24 hours, supplying the stamps, wash houses, etc. The stamp machinery, washers, etc., are driven by a compound Leavitt engine, and are supplied with very expensive wire rope transmission. The Calumet mill is lighted by the Brush electric light, and the Hecla mill with the Siemen's; 12 lamps in each mill. In each mine is a man engine, going down about 1,700 feet at the present time, but gradually being extended to greater depth. The high explosive used is No. 2 Hercules.

President, Alexander Agassiz; Secretary and Treasurer, Chas. W. Seabury; office, No. 67 Milk street, Boston, Mass. Agent, J. N. Wright, Calumet, Mich.

THE SCHOOLCRAFT MINING COMPANY.

The Schoolcraft Mining Company was organized in 1863. The property adjoins the Calumet and Hecla lands on the north, being the S. E. $\frac{1}{4}$ of Sec. 12, T. 56, R. 33, and work began and was prosecuted on the Calumet and Hecla conglomerate. The company expended its entire capital stock in unsuc-

cessful efforts to produce a paying mine, and in about 1873 was obliged to shut down for want of funds, or of any reasonable expectation of ultimate success. The mine was then leased to Capt. Wm. Harris, who expended considerable money in what he thought would be a profitable venture of working over the burrows, etc., but which proved otherwise. The company expended its resources and went into bankruptcy, and the property was bought at a bankrupt sale in 1876, and the organization of a new company decided upon by the purchasers to be called the Centennial, which project was consummated about two years later; capital stock, $1,000,000 in 40,000 shares.

Recently the new company have begun work on the Osceola amygdaloid, which crosses the property. Two shafts are started, 660 feet apart, and are now down nearly to the first level; judging from present appearances there is every indication of promise. The vein is, thus far, opening favorably.

There are some improvements on the property, in the way of agent's house, office, dwellings for miners, etc., and mining plant; two hoisting engines, and one pumping engine; a stamp mill with 32 heads of Gates' improved stamps, all intact. The water is supplied by a launder from a dam in Calumet creek. The property is but a short distance from the village of Red Jacket. The officers are S. L. Smith, president; Jesse Hoyt, secretary and treasurer; office, New York; William Harris, acting agent, Houghton, Michigan.

THE ALLOUEZ MINING COMPANY.

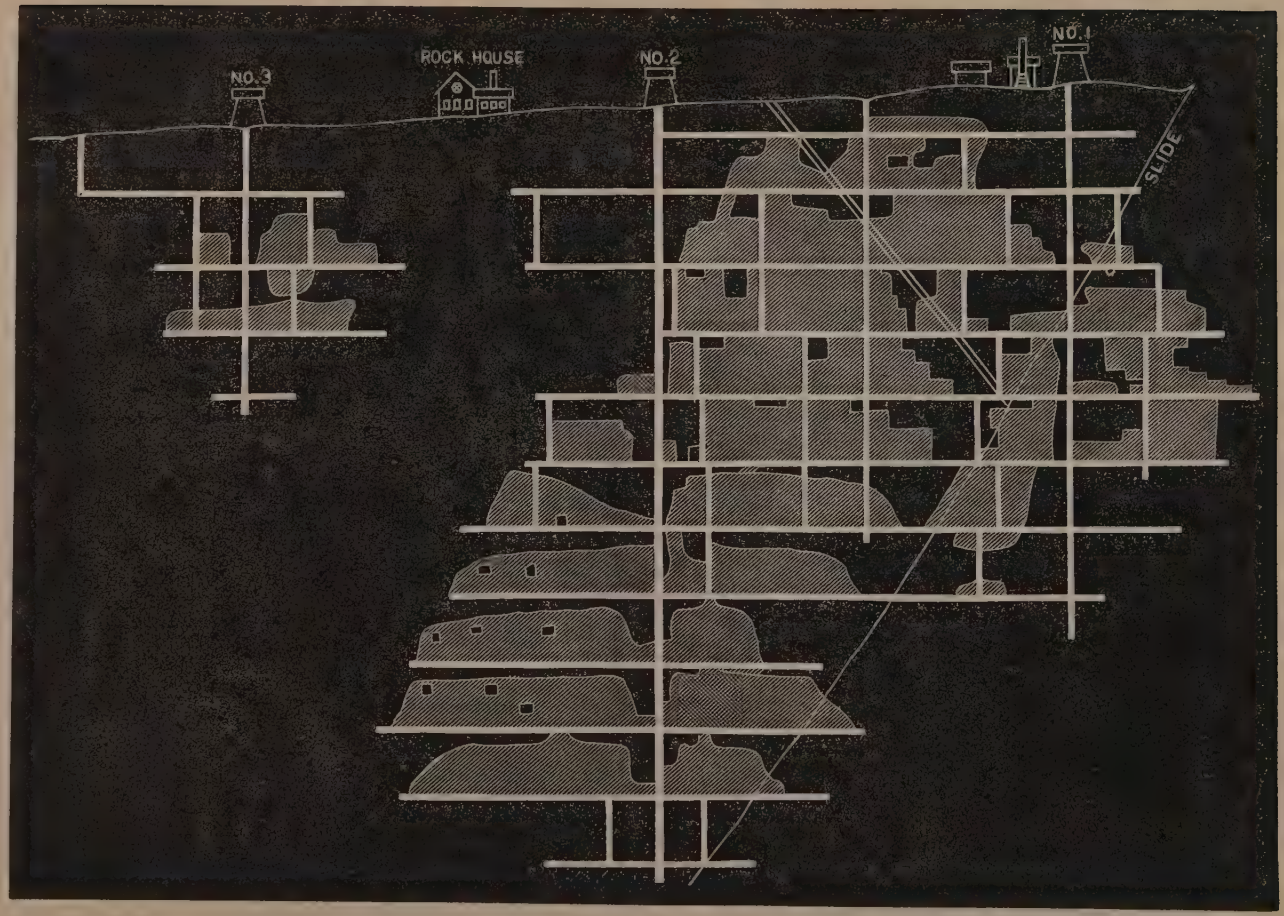
This company was originally organized in 1859, and held 2,800 acres of land in the southwest part of Keweenaw county, but the mine is situated in the S. ½ of Sec. 31, on the county line, T. 57, R. 32. Although the company is an old one, but little except exploring work was done during the first 10 years, and in 1869 it was decided to begin on the conglomerate belt, since known as the Allouez conglomerate. This belt is the same that immediately underlies the greenstone extending through the whole length of the trap range of Keweenaw county, and is now also being opened at the Delaware mine.

At the Allouez, the lode bears N. 39° E., and dips to the northwest 38°. It varies in width from 10 feet to 30 feet, and yields in mineral 1.30 per cent to 1.50 per cent, a fair percentage as compared with the majority of the mines. The work in 1869 consisted in sinking No. 1 shaft, commencing No. 2, extending a drift, and sinking a winze. A temporary suspension occurred, but work was resumed again in 1870, and in 1871 arrangements were made and work from that time was pushed forward on a large scale, and continued until September, 1877. During these years the mine was opened with three shafts sunk, the deepest 750 feet, and levels which extended in extreme length 1,600 feet. Houses sufficient for a working population of 400 men were built, together with agent's house, office, store, warehouse, shops, rock house, stamp mill, railroad, etc. The mine was under the charge of Captain A. P. Thomas, now agent of the Conglomerate Mining Company.

The company exhausted its capital stock, and contracted, in addition, a heavy indebtedness, and suspended work in September, 1877, or rather leased the mine to Messrs. Watson & Walls, who at that date began operating the mine on tribute, by which the company was to receive one-eighth of the product, clear of all expense. The lease expired in September last, and the company again resumed control of the property, and began to work the mine under a new organization which has been made, making the capital stock $2,000,000,

LONGITUDINAL SECTION OF THE ALLOUEZ MINE.

Scale, 300 ft. to one inch.



in 80,000 shares. An assessment of $1 per share ($80,000) was made to liquidate the indebtedness and furnish a working capital.

Under the lease were produced:

	Tons and Pounds Ingot.	Tons of Rock Hoisted.	Per cent of Copper in Rock.	Per cent of Ingot in Copper.
In 1877	2,026,729 lbs.	------	----	----
" 1878	827 tons, 25 lbs.	81,000	1.37	76
" 1879	735 tons, 1,611 lbs.	67,000	1.45	75½
" 1880	685 tons, 1,088 lbs.	73,000	1.30	----

The cost of crushing the rock at the stamp mill during the past two years has been 52 cents per ton. About five per cent of the rock hoisted has been rejected. Mr. Fred Smith, the company's efficient and gentlemanly agent has resided on the location during the period of the lease, to look after the interests of the company, and is now conducting the operations. A longitudinal section of the mine accompanying this report shows the underground workings to the present time.

The mine is opened to a depth of 1,060 feet, and the three shafts are connected with the rock house, each with a separate track laid on trestle work, operated with wire ropes, automatically. At present the hoisting is all done in No. 3 shaft, which is fitted with a skip road, and the cars run from the shaft house to the rock house on the automatic elevated railway previously mentioned. The rock house is furnished with six Blake's crushers, one of which is 18x24 inches, and it is connected with the stamp mill by a railroad, 4-foot gauge, operated by locomotive engine. The road is two and one-fourth miles long.

The mine is situated on Hill's creek. This stream supplies a portion of the water necessary for the purposes of treating the rock, and is brought in from a pond made by a dam across the stream, in a launder; a part of the water is obtained from Gratiot creek, conducted to the mine in a launder. The mill is provided with two Ball's stamps, 12-inch cylinders, and with 28 Collum's washers.

Mr. Smith is endeavoring to open the mine ahead, and also to furnish the ground for present stoping; about 300 men are employed. Two Burleigh drills are in use and a Rand drill is on the ground for trial. After the expiration of a three years' lease a good deal needs naturally to be done on the location, especially to the machinery and in opening ahead in the mine. The contract has been let for the manufacture of new friction gears of more approved pattern than that now in use.

The conglomerate lode has an extent on the property of 3,000 feet, and lying north of it will doubtless be found the ash bed, but no effort has been made to determine the fact. The officers are Emmerson Coleman, President; William C. Stewart, Secretary and Treasurer; office No. 29 Drexel building, 25 Wall street, New York. Fred Smith, Agent, Allouez, Michigan.

ISLE ROYAL.

In the commencement of copper mining on Lake Superior, a great deal of attention was given to Isle Royal. Very uncertain, but extravagant notions prevailed regarding its mineral value; numerous cupriferous veins were observed along the shore, and formed the basis of much wild conjecturing. It

was even at first asserted that the copper masses found here and there on the mainland had been derived from Isle Royal, carried by the ice in some former geological epoch.

The island is situated about 50 miles from Keweenaw point, and is 75 miles in length, 8 miles in width in the widest portion,—the south end of the island, and about 2½ miles at the north end. The island is formed of thin beds of trap, running longitudinally; is indented with numerous bays and coves, some of which form excellent harbors; and is covered with a dense growth of dwarfish forest trees, largely of the evergreen species. The formation is crossed, as in Keweenaw county, by numerous copper-bearing veins, and veins also frequently occur conforming in direction with the trend of the rock, but dipping at angles independent of the dip of the formation. The frequent change in the formation, arising from the thin bedding or strata of the rocks, affects in a corresponding degree the character of the veins, making the work of mining in them exceedingly uncertain and causing all the mining ventures which have thus far been made on the island, to prove unprofitable undertakings.

All the mines which have been opened were situated near the shore, and mining work was prosecuted with considerable zeal prior to 1853, after which time the island was practically abandoned for a period of 20 years, after which time attention was directed to the extensive "Indian diggings," which are found to occur here in, perhaps, greater quantity than elsewhere in the copper district. In 1872 Mr. S. W. Hill did some exploring work on the island, and as a result the Island Copper Mining Company was formed, and a force of men put to work on the location, near the southern extremity of Siskiwit bay. Work was continued three years, when the company suspended operations. The mine was let on tribute. A small stamp mill was built in the fall of 1875 to work up the accumulated stamp rock, but was destroyed by fire very soon after. The total shipments of the mine were about 68½ tons of refined copper.

THE MINONG COPPER COMPANY

is located near McCargoe's cove, on the northwest side of the island. The company was organized in 1874, and commenced working a lateral vein which lies about a mile from the lake shore, and which was marked for a great distance with ancient pits. A stamp mill was built in 1876, and furnished with a Ball's stamp. The rock was found to yield about one per cent ingot copper; 1,579½ tons of rock treated in 1876 gave 20¼ tons of mineral. A diamond drill was employed in the exploring work. In 1877 the company produced 72,737 pounds of ingot copper, and employed 30 men. The expenditures were $126,943.34. At the present time there are a few men working on tribute, producing in 1880 about 13 tons of copper. The officers are Hiram Walker, President, E. W. Hudson, Secretary and Treasurer, Detroit, Mich.

In visiting the copper district, while collecting the data of the foregoing pages, the writer must acknowledge his obligation to the mining agents to whom he is indebted for many kindnesses, courtesies and favors voluntarily extended, which these gentlemen, with few exceptions, have uniformly given. They have combined hospitality with a readiness to accord any information in their power to convey. Obligation is also most cheerfully rendered to Messrs. J. R. Devereaux, editor of the Houghton Mining Gazette, E. P. Kibbee, editor of the Northwestern Mining Journal, Hancock, Mich., and Alfred Meads, editor of the Ontonagon Miner, for information obtained. These gentlemen very freely gave the writer access to their files, and the use of their mining reports and other sources of information collected in their offices.

MARQUETTE IRON DISTRICT.

JACKSON MINE.

In one particular this celebrated mine out-ranks all the others in the district: it was the first discovered iron ore deposit in the region, and the company is the oldest corporation, and the mine was the earliest worked, and from the ore of the Jackson the first iron was made ever obtained from the deposits of Lake Superior. In many other particulars is the Jackson mine entitled to eminent consideration. The excellent quality of its product early served to establish the reputation of the Lake Superior ores, and the magnitude of its shipments, and the great financial success of the company stimulated mining enterprise, practical exploration, investment of capital immigration, and the settlement and improvement of the country.

The company derives its name from the city, where, in 1845, the association was originally formed. The parties to this organization were Abram V. Berry, P. M. Everett, S. T., G. W. and F. W. Carr, E. M. Rockwell, F. W. Kirtland, W. H. Munroe, A. W. Ernst, and F. Farrand, of Jackson, Michigan.

In 1848 a reorganization of the company was effected under an act of incorporation passed by the legislature of Michigan, and the name assumed was the Jackson Mining Company of Michigan. The present title of the company is the Jackson Iron Company. A short time previously, however, a forge had been constructed on the Carp river, in which the first iron ore was made into blooms. The daily product of this forge, when in full blast, was about three tons of iron. The manufacture of blooms in this forge was abandoned in 1856.

In 1850 about five tons of the ore had been taken to Newcastle, Pa., and there worked up. This small shipment was followed two years later by one of 70 tons, taken to Sharon, Pa., which was smelted in a blast furnace. The first regular shipments from the mine began in 1856, the company shipping that year 5,000 tons. The aggregate shipments since that date amount to upwards of 2,000,000 tons of ore, being nearly the same as the Cleveland, which also began about the same time, and until 1864 the Jackson, Cleveland, and Lake Superior were the only companies which shipped ore from the region. Geologically the formation at the Jackson possesses great irregularity, and the occurrence of the ore deposits is largely a matter of conjecture, and their continuance, when formed, is only determined by the working. Extensive explorations are constantly made in the mine by means of trial shafts, cross-cuts, and drifts made here and there, seemingly, to the novice, at random, but really located with the greatest care by Captain Merry, whose 20 years' experience in charge of the mines and the company's interests have given him a degree of

familiarity with all the difficulties to be encountered, and a knowledge of the peculiarities of the formation.

The ore has always been in the greatest demand, bringing the highest prices, owing to its superior quality, and the care which has been observed in selecting it. In the east end mine, No. 7 and old No. 1 pits, the product is the best grade of hematite, possessing a percentage of manganese, and also of chromium. Even here occur veins or pockets of hard ore, alternating with the soft ore deposits. The formation is exceedingly contorted and broken up, the veins doubling and folding in a manner nearly defying definite determination.

The somewhat friable, disintegrated character of the rock has added an element of perplexity to the problem of how best to find and to win the ore. The success of the company, however, and the condition of the mine sufficiently indicate that the difficulties have been understood and economically overcome. The Jackson is the most easterly mine in the district, producing first-class specular ore.

The most easterly portion of the mine is No. 7 pit, a deep open excavation close to the railroad track, and main street in the west end of the city of Negaunee. From the bottom of this pit extend in nearly all directions short drifts and openings. At the extreme west end a tunnel starts; bending around to the north and assuming a northwest direction it extends a distance of 600 feet, passing beneath the railroad and Capt. Merry's house. This drift, as are most of the drifts that have been run, is mainly for the purpose of exploration, but some ore has been intercepted near the north end which it is hoped will be a lead to a larger deposit, and it is contemplated to sink at this point from the surface. A second tunnel runs west from the bottom of the open pit, 200 feet through rock but showing no ore. A little to the south of east a vein has been followed 250 feet, and a large amount of ore mined out, and they are still stoping in this direction. At 100 feet from the opening they are following a vein which narrows at the bottom and widens out upwards; to the west it dips down under a wall of rock that cuts the top of the vein. The product of this pit is estimated at 10,000 tons; the quality is very superior, mostly manganiferous hematite. There is also some hard ore obtained.

To the west we come to No. 1 pit, and from here the underground workings extend west a distance of 1,900 feet, and an extreme distance north and south of 600 feet. In the second level, a distance below datum of 150 to 170 feet, the workings are all connected, the pits to the east, Nos. 1, 2 and 3 being connected with those to the west by a drift 300 feet in length.

No. 1 pit is mined out on the second level over an area of 200 feet square, and is connected with No. 2 by an irregular drift 175 feet long; thence southwesterly 300x100 feet, the ground has been all stoped out, no sinking having been done in this part of the mine below the second level which has been worked out so that no mining is doing in these pits. To the west a tunnel 300 feet long, running N. 50° E. intersects another drift of equal length running at the same angle to the southwest, and both united, immediately open into No. 5. The open portion of this pit presents on the north a vertical wall 100 feet high which is separated by a rock partition penetrated with an arched opening from another similar roofless chamber to the east. In the south and east parts of this pit they are now mining, and have also extended drifts to the south and to the east which have intersected deposits of ore to facilitate the mining of which two shafts are lowering from the surface; one of these deposits is a vein of ore crossing the formation. In the west end of No. 5 an open-

ing has just been made in the bottom by the miners below, working east from No. 6 in the fourth level, breaking through.

Passing down through this aperature, or which is perhaps the more preferable way, ascending to the surface and descending the shaft which starts near the engine house, and inclines at a steep angle to the south, we arrive into the main productive portion of the mine. In this pit the vein is worked in the fifth, sixth and seventh levels, the bottom being 350 feet below the datum level. The walls of the vein are nearly vertical, and in the fifth level it has been worked out to a distance east from the shaft of nearly 200 feet, and to a width of from 12 to 25 feet; at the end it presents a stope of nearly 40 feet in height, on which the miners are taking down the ore. Above the floors have been generally mined out, and in their place, when needed, timbers have been substituted. To the west, in this level, the vein has been mined out to a distance of 100 feet from the shaft, and presents at the end an equally favorable appearance. A drift reaching to the south 100 feet struck a pocket of ore, which is also taking out. At about half-way along this latter drift there starts to the southwesterly an irregular tunnel, which intersected some productive deposits of ore. This drift opens into the east end of the underground workings of the Pioneer mine, the most easterly pit on the location.

Starting near the shaft in the fifth level is a tunnel which has been driven through the rock 450 feet. This work has been in progress for three years and is mainly exploratory; some ore has been found in a small vein, which Capt. Merry thinks is only a leader. He feels certain that the ore is there, and that the drift will find it. In a recess opening into this drift is set the pump which hoists the water collected in this level, and pumped up from the lower levels to the surface. The ore from the several stopes is trammed to the shute, from which it is drawn out into the hoisting skip. Descending to the sixth level, 301½ feet below datum, we find the vein to be considerably widened and more uniform in its width. It has been mined to the east and to the west about 60 feet each way, and at either end of the drift thus made are stopes 40 feet in height and 20 to 25 feet in width. In the bottom the men are sinking in the ore to another level, and the depth now reached is the lowest attained in the mine.

The product from all that portion of the mine between No. 7 pit and the Pioneer is hoisted to the first level and thence trammed to the ore pockets, of which there are four. The cars are drawn into and out of the mine by a small locomotive engine, and are filled from the shutes. The track is laid into the mine from the north, connecting with the Northwestern road, and passing through a tunnel, which, with its branch to the last, is 500 feet in length.

The Pioneer mine is the most westerly pit on the location. It is worked by the Iron Cliff Company, and the ore is used in the Pioneer furnaces at Negaunee. The pit is opened in the fifth level a distance of 300 feet east and west and 10 to 60 feet north and south, and with a long drift extending southeasterly. In the sixth level the vein has been mined a distance of 225 feet and to a width of about 10 feet, with a wider head or pocket towards the east end; extending southeasterly in this branch the vein has a width of 15 feet. To the west it widens out into an irregular deposit that has been worked out. In the seventh level, 321½ feet below datum, the workings to the north and to the east extend 75 feet each way, and at the south and west a much shorter distance. These openings are 10 feet in width, occasionally branching out to 15 feet, but the pit appears to be nearly exhausted. The miners are working here and there, wherever a little ore can be obtained.

The most favorable stoping ground at present in this pit is in the vein which is proving so productive in No. 6. The Pioneer is working easterly in this deposit, and is also sinking from the surface, the better to work this ground to the east.

Recently the Iron Cliff have begun working the North Jackson, as it is called, which is situated 200 to 300 feet north of the main workings, and between the lines of the C. & N. W. Ry., and the M. H. & O. R. R. The vein here dips to the west at a sharp angle, and its course is nearly north and south; it has been worked in an open pit down to a depth of 50 feet, and for a distance of about 200 feet. They are now taking out ore at several points in the pit, and are also sinking to intersect the north drift from No. 6. The product from the Pioneer workings, the past year, was about 27,000 tons.

The South Jackson is the most westerly pit of the Negaunee hematite openings, and is in the southeast part of the company's property; the section corner-post stands upon the edge of the south pit, and the line west from it crosses the opening, cutting off the north part of the Iron Cliff, and the line from the stake, south, cuts off a portion of the pit to the east, belonging to McComber Company.

The pit is now idle, but during the past winter—1880–81—it was actively worked, the Jackson Company having taken out several thousand tons of ore, which are now in the stock pile. In the winter there was no water, but when spring opened the water came in, and as the mine was unprovided with a pump, work here was suspended. The workings extend down about 70 feet deep in the west end, and the ore in the bottom still continues good, though the vein is not wide. To the northwest a short distance is the main pit, and is now vigorously working. This pit is about 350 feet in length, and the depth to the first bottom is about 30 feet. Near the center and at the west end they are sinking another level, and are down below the first a distance of 40 feet. Below the first floor a tunnel comes in from the north, laid with a railroad track, and is entered by the cars, which are filled from the dock laid on a level with the first floor. This tunnel has been extended a distance of 500 feet further to the south, to the diorite bluff, without finding ore, except in one pocket, which proved to be of limited extent east and west from the line of the drift.

In the west end of this pit the diorite comes in from the south, and partially cuts off the vein or pushes it to the north, and the company have opened again to the west of this diorite spur. A diminutive engine and drum does the hoisting. The product of the South Jackson is about 25,000 tons of an excellent quality of soft hematite, corresponding with the McComber, Grand Central, etc. The ore is carefully picked, and although somewhat mixed as it comes from the mine, the rock is all sorted out.

The drilling is all done by hand; the company has no compressor, and uses no power drills. Captain Merry does not regard their use as likely to prove economical or advantageous in this mine; neither is the diamond drill used to any great extent, at least to a degree at all comparable to the extent in which it is used in some of the great mines in the district. The difficulties attending its use arise mainly from the peculiar nature of the rock; the small, loose pieces of hard jasper wear out the diamond so rapidly that it is almost impossible to proceed.

Capt. Henry Merry has been in charge of the mine since nearly the commencement of operations, and while, as this long continued service shows he has maintained the confidence of his employers, he has ever possessed in an equal degree the good will of the employés of the company, and enjoys the

reputation throughout the region of being not only a skillful miner, but an upright, faithful citizen.

CLEVELAND MINE.

The estate of this important company comprises 2,200 acres, situated mainly in sections 2, 3, 10, 11, T. 47, R. 27, but the principal workings are in the north part of the east half of Sec. 10 and west half of Sec. 11, adjoining the Lake Superior and the New York mines.

These lands were first taken by a "permit" from the war department, by Dr. Cassels, of Cleveland, in 1846. This gentleman visited Lake Superior in the interest of the Dead River Silver and Copper Mining Company, of Cleveland. Dr. Cassels was directed to the locality by Mr. Everett and party, who had previously secured the Jackson Company's lands, lying adjacent to the east. Other parties subsequently entered upon the lands and instituted a pre-emption or mining right claim, but the title was finally accorded to the Cleveland Company.

Although the association was previously formed, the company did not do any business on Lake Superior until 1853, at which date the present Cleveland Iron Company was organized, and in following year the company mined 4,000 tons of ore, which was made into blooms at the several forges in the country; and in 1855 the company shipped 1,449 tons of ore down the lakes to the furnaces to be made into pig iron, anticipating the shipments of the Jackson Company one year, and thus becoming the first company to ship from the region any considerable amount of iron ore. This small beginning grew from year to year till the annual product exceeded 150,000 tons, affording at the present time an aggregate of shipments of over 2,000,000 tons of ore of a quality which has been ranked with the best in the market; and perhaps no mine in the district affords a better assurance of continuing to yield in the future as in the past than does the Cleveland.

Commencing with No. 1, in the northwest corner of section 11, the east part has been worked out and the mine is working to the west; at this end of the pit, at 43 feet below the datum, about 100 feet down from the immediate surface, the vein is about 20 feet high and 12 feet wide. From here has been taken during the past year about 1,200 tons of ore.

No. 2 is considered as being worked out, although there is some ore in the west end, but the pit has not been mined for the past year.

No. 3, the largest mine on the location, adjoining the New York mine on the south, is also being pushed to the west. The roof of the entire eastern portion of this pit—the extent of the underground workings of the pit up to that date—fell in two years ago, causing a good deal of delay in the mining and an expenditure of $40,000 in clearing and constructing, ready to resume work. This seeming misfortune was, however, no disadvantage, as the portion of the mine which fell in was mainly worked out, and the mine is now much safer. The principal workings in the western end of the mine are close to the hanging wall; the length of the stopes is about 160 feet, and in height from 15 feet to 45 feet. On the north they are cutting through the ore to the New York line, leaving large pillars upon either side. Some work is being done in the south part of this pit on a stope 100 feet long. The total product of the pit is about 300 tons of ore per day, which is run up to the surface on two single and one double skips. The skip roads are furnished with switches, which facilitate the hoisting of a greatly increased amount. Six or seven Rand drills are in use in

this pit. On the south the quartzite seems to be working in, creating an apprehension that the vein may be cut off, but a drill hole sunk 240 feet to the southwest passed through 60 feet of ore at 240 feet from the surface. The quality of the ore struck in this drill hole is first-class.

Nos. 4 and 5 lie southeast from No. 3; the former is mined out. The men are "scramming" the pillars to get out what ore can be saved intending to let the roof fall in. But No. 5 is working in the west end down about 100 feet; the east part is mined out, and the outlook is not favorable for a long continuance of working in any portion of it. There is a stope of perhaps 20 feet of first-class ore, and the rest is second-class. Connected with the west part of this pit and lying northwest of it, is the No. 6. Operations in the west part of this pit were a short time ago partially interrupted by the fact that the mining had approached as near as safety would admit, to the tunnel which conducts the water to the pumping shaft. They went 200 feet east and sunk below the water tunnel, intending to drift under it. Some jasper is coming in, and on the whole the pit is not regarded as looking very promising; but eight men are at work in it, and they have mined from it only about 2,000 tons of ore the past year, much of the time having been taken up in sinking. An increased product will be obtained the ensuing year.

Lying west of No. 6, and opening into it is the incline pit, the most important of the company's present workings. The southerly portion of this mine consists of an open pit upwards of 300 feet in length, and from 120 to 140 feet in breadth at the surface, which has been mined out; thence following the dip of the vein the mine extends underground to the northwesterly, a horizontal distance of from 150 feet to 200 feet, attaining a depth of from 112 feet to 190 feet below the datum level. At the westerly end of this pit there are at the present time an aggregate length of stopes of 280 feet, and fully 60 feet in height, and there are still 20 feet of ore between the bottom of the workings and the foot wall, thus giving a width of vein of 80 feet of first-class ore. At the present writing the men are mainly engaged in breaking up and hoisting the ore, of which there are about 15,000 tons that has previously been thrown down from the stopes. Heavy pillars of ore are being left to support the roof, and near the open portion of the pit some large crib pillars made up of timber and filled in with stone have been added as an additional security. Considerable difficulty is naturally experienced in mining a vein of such enormous thickness. The method pursued is to drift through the ore to the hanging wall of the vein and stope down to the level of the drift, and then to sink again in the ore and proceed in like manner until the foot wall is reached.

In addition to the lamps carried by the miners, the electric light is used. From five to seven power drills (Rand's) are used in this pit. The pit is entered by three skip roads carrying five switch tracks which are operated by a new hoisting engine made at the Marquette foundry and machine works—cylinder 20 inch diameter, 30 inch stroke, variable cut-off. The hoisting drums are 6 inch diameter. In the same building is also placed the duplex Rand's compressor—cylinder 16x30 inches.

Situated 500 feet to the south of the west end of the last described openings is the saw mill pit. This opening presents many peculiarities. Not long ago it was thought that the deposit would soon be exhausted, owing to the jasper coming in at the top, but subsequent work developed the fact that the ore pitches under the jasper and comes out on the other side; as now looking the thickness of the vein in this direction will be 30 feet. In the previous workings in this pit the ore has been taken out to a height of 50 feet. Only

hand drills are used and about 100 tons of ore per day are mined, which are hoisted up by a single skip. This product is estimated as good as it is possible for ore to be; analysis shows it to be exceedingly pure, and this result is verified in the furnace. Two diamond drill holes have been sunk from this pit during the past year in one of them at a distance of 37 feet; 12 feet of ore was passed through. In the other hole only jasper was found.

Nos. 7 and 8 pits are worked out and in No. 9, the most easterly with the exception of the hematite pit, work was stopped in April last (1881).

No. 10, the hematite pit, is nearly a mile to the east, being but a few hundred feet from the east line of the Jackson property. This pit also seems to be nearly exhausted. Work here has never proved profitable, but has been continued, hoping for better results. Two drifts have lately been started, one of which is in ore, but has not yet been pushed sufficiently far to determine anything. Work has been temporarily suspended, but the pump is kept at work to prevent the mine filling with water. No work has lately been done at the old school-house pit which once produced 30,000 tons of ore annually.

On the location is a machine shop, carpenter shop, etc. The company also operate two locomotive engines and possess an ore dock at Marquette which is furnished with 114 ore pockets and six steamboat pockets. The officers of the company are J. C. Morse, Agent, Marquette, Michigan; D. H. Bacon, Superintendent, Ishpeming, Michigan.

NEW YORK IRON MINE.

This mining property comprises the S. E. ¼ of the S. E. of Sec. 3, T. 47, R. 27, the fee simple of which is held by Mr. A. R. Harlow, of Marquette, Mich. The land is hemmed in on the north and south by the Cleveland estate, and in an early day when the Cleveland Company commenced its mining operations, its officers were desirous of purchasing this property, lying in such close proximity to their workings, but Mr. Harlow, fortunately for himself, declined to sell, and subsequently, upon the discovery that it held a large deposit of ore adjoining the Cleveland mine, a lease of the land was secured of Mr. Harlow for a term of years, including a mining right, at 25 cents per ton royalty. A company was organized in 1865, the greater portion of the stock being held by Mr. Samuel J. Tilden, of New York, who afterwards became the sole owner of the lease.

The estate comprises but 40 acres of land, and the mine workings are comparatively limited in extent, yet from this small area has been taken upwards of 900,000 tons of rich specular ore, and while the mine fails to afford its former magnificent product, still an annual yield of perhaps 60,000 tons is no insignificant output for so small a mine.

The bottom of the mine in the several shafts, and the backs of the different levels, the breasts and stopes which are seen, yet reveal, in the aggregate, an abundance of ore for present mining, and the promise afforded by the outlook in some portions of the mine that its existence as a large producing mine is likely to be prolonged for many years to come.

The company is shipping none but first-class ore, but in order to accomplish this a good deal of assorting is rendered necessary, occasioning also the necessity of washing much of the ore. This labor increases materially the cost of production. The second-class ore, which is less than 10 per cent of the product, is stocked and held.

There are four shafts, or skip roads, operated in the mine. Nos. 2 and 3

descending into the east mine start from the same shaft house, but rapidly diverge as they go down, since owing to the sharp bend in the formation the one, No. 3, descends to the south, and the other, No. 2, to the west. These shafts are down about 300 feet on the incline. From the bottom of No. 3 they have worked to the Cleveland line, and can go no further in the direction of the hanging wall side, but are stoping on the foot wall, having here breasts of ore to the easterly and westerly 20 or 30 feet in height and of equal breadth. From this pit the captain estimates a product of 20,000 tons the present year, and the bottom is favorable for obtaining, by sinking, an equally productive lift the following year. But while a continuance of the ore will give workable ground ground in this part of the mine for a few years to come, they must within a lime time work out the whole of this deposit to the south line of the property. No. 2 shaft does not furnish a large amount of first-class ore; the estimate is between 6,000 and 8,000 tons.

From No. 2 the vein makes another twist, so that No. 4, which is about 200 feet distant to the northwest, measured on the surface, but which rapidly converges towards the former as it goes down, has an inclination to the south, and No. 5 again more to the west. At the bottom of No. 4 are to be seen some fine stopes of ore, but the deposit at intervals is interrupted by horses of jasper. A stope at the east is 16 feet in width and has been formed to 80 feet in length, and directly above on the next level is a body of ore equally as good.

While there are many difficulties to contend with in working the mine, yet, as before stated, there is an abundant assurance of a large yield of ore for many years to come.

No. 6 is a small opening some distance to the northwest which has been worked for several years, and a limited quantity of ore obtained; scarcely enough, however, to repay the cost of working. Operations are continued in the hope that something better may result. The pit is down about 100 feet, and a small engine does the pumping and hoisting.

The mine is supplied with a compressor, and there are six power drills being used. The force employed is about 250 men.

The water is pumped from the mine through No. 1 shaft, which is used only for this purpose. The shaft was originally sunk with the expectation of reaching a large body of ore, but none of any considerable value was found.

Capt. W. E. Dickinson, the former efficient superintendent of the mine, resigned in March last, and has been succeeded by Mr. J. H. McCloskey.

LAKE SUPERIOR MINE.

With the exception, perhaps, of the Jackson, none of the great mines of Marquette county have experienced more fully the difficulty incident to the mines of this district, arising from the nature of the deposits of ore. The foldings, the contorted character of the formation, the sudden appearance or disappearance, the widening out or narrowing up of veins or horses of ore, seem, in this mine to have attained a climax, affording many knotty problems both to the geologist and to the miner.

The results of the earlier mining in old No. 1 pit, owing to the remarkable folding of the vein, as still observable in the westerly wall of the pit, led to the expressed opinion, by a prominent scientific authority, that the ore deposits were probably shallow. A similar occurrence at the same time at the Jackson mine, where the bottom of the deposit seemed to have been found, seemed to strengthen the opinion that the ore deposits might be wanting in depth. So

little was known at that time regarding the geology of the country and the nature of the rock formations, and of the character of the iron ore deposits, that it is not surprising that so intelligent and courageous a gentleman as Mr. C. H. Hall, agent of the company, should have been troubled with apprehensions regarding the persistence of the ore.

But notwithstanding the discouragements, the obstacles which have been met with have been surmounted, so that the mine has ever maintained a position in the front rank of the mines of the iron district, both as regards the quantity and the quality of the product; and to-day, as one examines the underground workings, and observes the important and substantial improvements that have been recently made, and are at present being carried forward on the surface, and acquaints himself with the persistent and successful efforts constantly in progress in the direction of further exploration, he cannot fail of the conclusion that in the future, as in the past, the mine is sure to sustain its well earned reputation.

The company is one of the oldest in the district, having been formed in 1853, with a capital stock of $300,000, which was subsequently increased to $500,000. Operations were begun in 1857 on Secs. 9 and 10, T. 47, R. 27—the seat of the present workings. The first shipments of ore—4,658 tons—were made in 1858, since which time the annual product has regularly increased until it has attained to upwards of 200,000 tons. Until about ten years ago the mining was all done in pits, open to the surface, some of which became of great size, and were carried down to depths of 100 feet to 210 feet.

At present the mining, with the partial exception of at A shaft, is all underground, and as regular a system of shafts and levels as a knowledge of the position and nature of the ore deposits will admit, is carried on.

The first level is 180 feet below the surface (datum); above that the workings were irregular. At 60 feet below the 180-foot level the second level is extended, but this distance proving too great, owing to the insecurity of the walls, the subsequent lower levels are driven at a vertical distance apart of 40 feet.

The A shaft, the most easterly one, inclines to the north at an angle of 67°, and is down 100 feet to the level of the bottom of the pit, from which the ore is being taken, and drawn up the shaft on the skip, worked by an engine, the water being abstracted by the pumping engine at the hematite mine, situated some distance to the southwest. The ore from the pit is trammed through a short drift to the shaft. The deposit here is the lower portion of a sharp minor fold, which extends upward to the surface of the rock formation, thence being covered with 30 feet of earth. The mining here will be extended westerly, the earth being stripped in advance, as the mining proceeds, rendering necessary the removal of buildings erected upon the surface.

Two diamond drill holes have been bored from A shaft to the north, the line of the lower one of which is to be followed by a shaft to reach below a deposit, showing 40 feet of ore that was found by a vertical boring 500 feet to the north.

Besides the A shaft there are five shafts fitted with skips and used for hoisting, designated as Nos. 1, 2, 3, 7, and hematite shafts. Nos. 1, 2, and 3 are connected underground, and the hoists in each are worked by the same engine by wire rope transmission. The water is drawn from this mine through an old shaft that is abandoned for any other purpose than as a pumping shaft. The old engine and hoisting apparatus proving inadequate, two new engines have

recently been set up, —— 22x48 inches each, and a new building for the hoisting apparatus is now being built, to be supplied with 4 drums of 12 feet diameter and 4-foot face, one drum each for Nos. 1 and 3 shafts, and two for No. 2 shaft, which is fitted with a double skip.

Descending No. 2 shaft and passing the 180 foot level, we arrive at the bottom of the 240 foot level; passing around a short distance to the west in an irregular opening, we go south through a cross-cut which extends through the minor folds of the ore deposit. The first fold of the vein which is reached by the cross-cut has a width of 25 feet with walls of chloritic schist. The vein continues westerly from this point a distance of 225 feet, and then turns to the northwest, extending into the Barnum property. Eighteen feet more of cross-cut to the south brings us to the second minor fold of the vein, of an equal width with the former but shorter extension west, opening into a large chamber from which the ore has been taken. In both of these tunnels the pitch is to the south about 75°. The product is a first-class slate ore.

Again passing through 12 feet more of cross-cut we come into the opening made in the third fold of the vein. Here the walls stand nearly vertical, and the vein is worked out to a width of 18 feet, and to the west a distance of 180 feet, but at 100 feet west it is united with the second fold making an enlargement of the vein to 60 feet in width. From this point the vein diverges to the northwest. These two portions of the vein come together in the 280-foot level at a distance of 100 feet east of the cross-cut.

Thirty feet further south through the cross-cut to the fourth or north fold of the vein, which is the main foot wall vein. To the east it unites with No. 3 vein at about 350 feet distant, and it is opened up in this level also to the west, a distance of 275 feet. This is the finest part of the mine so far as regularity is concerned. The walls are regular and have a parallel inclination of 82° and are about 20 feet apart. The stopes at the extremities of each of these veins are showing equally promising for a yield of ore as are the floors of the level. At the west end of what is termed the long drift in this level, that is 40 feet north and 250 feet west from the No. 3 shaft, a diamond drill hole was bored in a southwest direction, inclining 2° with the horizon, which at 74 feet passed through 21 feet of first-class ore, and at 274 feet came to 28 feet of slightly mixed ore. A drift was extended on the line of this hole which resulted in showing that the first body of ore corresponded with the first fold to the north. A hole was also driven in the opposite direction 420 feet, but found nothing but rock.

No. 3 shaft starts from the surface but a few feet from the Barnum line, and in the 240th level we soon reach the Barnum openings as we go northwesterly from this shaft. In the 280-foot level, down to which the shafts extend, the north vein has been struck at 50 feet distant, and opened 40 feet in one direction and 30 feet in the other. In this part of the mine are stopes of extraordinary magnitude.

Going back to No. 3 shaft and descending to the 280-foot level, and proceeding south through a cross-cut 50 feet, we again come into No. 1 fold of vein which is opened to the west 200 feet, appearing about as in the level above. Twelve feet more of cross-cut strikes No. 2 which is opened to the west 250 feet, and to the east 300 feet. The vein shortens and narrows to the east more and more in each successive level and in a corresponding degree; marks in magnitude in the opposite direction.

The points of union of the folds are found to be further to the west as we go

deeper. The main southerly fold preserves the regularity which characterizes it in the 240-foot level, though the vein has not yet been worked as far west into 250 feet as it has in the level above.

Descending to the 320-foot, the lowest level, we reach, through 40 feet of cross-cut, the No. 1 fold of vein, which has almost disappeared, and at a short distance further in the cut we find No. 2 and 3 folds united in ore which they have just commenced to work. No. 4 foot wall vein has been worked a distance of about 100 feet in this level, the floors and stopes remaining equally good as in the levels above.

No. 6 shaft, several hundred feet southwesterly from No. 3, is sunk to the 180-foot level, and is being lined up and made ready for a skip. The frame of a shaft house has been erected. The water is raised by the pump at No. 7, and the hoisting will be done from No. 7 by wire rope transmission. No ore has been raised from the shaft. Between Nos. 3 and 6 and between shafts 6 and 7 a number of diamond drill holes have been sunk, none of which struck first-class ore.

At No. 7, the most westerly of the company's mines, there are two shafts, the oldest of which will be abandoned as soon as the later one is carried down to the lowest level in the mine. Descending the most easterly of the two shafts to the 1st level, 60 feet below the surface, we find a well defined vein of ore that has been worked out to the west a distance of 75 feet and to the east 100 feet. The hanging wall is chloritic schist and the foot wall a quartzite. The ore is good second-class. Descending to the second level, we find it opened to the west 125 feet to the old No. 7 shaft, and to the east 300 feet. In this direction the vein is seven or eight feet wide; to the west the width is 12 feet, the foot and hanging walls remaining as above, and the product a hard steel ore rather second-class. Descending 40 feet, we reach the third level, and going east we find the vein to have been worked out a width of 30 to 40 feet for a distance of 140 feet. The vein dips to the north at an angle of 50°; further to the east the vein narrows. At 250 feet east from the shaft a cross-cut was driven to the north 60 feet without developing ore. The quartzite hanging wall passes into a schistose rock in this level. Descending from the foot of the shaft down a breast of ore 40 feet high that is being stoped easterly, we reach the fourth level. Here we find the deposit of great width and of the best quality. Going west to old No. 7 and beyond we find a floor of over 300 feet wide, with walls diverging downwards and contracting upwards and further to the west, until the vein seems to terminate.

The whole length of this mine underground is 560 feet, and the average width of vein about 20 feet.

A new stone engine house has been built the past year, and new hoisting apparatus put in which includes two Lane's drums, 6-foot diameter and 4-foot face.

THE HEMATITE MINE.

The remaining mine is the Hematite, which lies to the south of the main mine. Here is a double skip shaft, down 200 feet below the surface. The opening underground is 450 feet in length and 50 feet wide. About 40,000 tons of ore are raised annually from this mine. A lower level will be started this summer. The pumping engine here pumps also from "A" shaft and the water for the city of Ishpeming, the water for the latter purpose being drawn from Lake Angeline. The steam for the pumping engine is brought from the boilers at No. 2 shaft.

Seven diamond drill holes have been sunk during the past year, the deepest being the one on the base-ball ground, north of "A" shaft, down 960 feet. Two other holes struck good deposits of ore.

The electric Bell telephone is used in the mines, and it is the intention to use the electric light also. Among the other important improvements made during the past year, not previously mentioned, is a commodious stone machine shop, supplied with lathes, etc., and run with an engine; also a new Rand's double compressor, which drives the drills in all the mines; 16 power drills are used. Side-tracks connect both with the C. & N. W. R. and with the M., H. & O. R. R. The mine employs about 500 men. The officers of the company are Joseph S. Fay, President; Richard S. Fay, Treasurer; A. C. Towns, Secretary; C. H. Hall, Agent.

BARNUM MINE.

This mine, the most important one owned by the Iron Cliffs Company, adjoins the Lake Superior, the line between the two properties extending east and west through a portion of workings of the two companies, the quarter post, the southeast corner of the Barnum mine, being near the edge of old No. 1 pit. The old mine is situated on the S. E. part of the N. ½ of Sec. 9, T. 47, R. 27. The new mine, which is being opened, is on the N. ½ of the N. W. ¼, Sec. 10. The first shipments of ore were made from the mine in 1868, consisting of 14,380 tons, which amount was more than doubled the succeeding year, and in 1870 the shipments were 44,793 tons, increased to 48,076 tons in 1873. In 1878 the product fell off 10,000 tons from that of the preceding year, and a still greater diminution made it only 24,015 in 1879, and 24,522 tons in 1880.

The falling off in the product, and the limited extent of ground in the old mine, rendered it evident that a change of base must be made; accordingly Superintendent Sedgwick, with the consent of the directors, commenced boring with the diamond drill. A number of holes were sunk, sufficient to develop the existence of a body of ore reaching to 50 feet in thickness, covered by from 350 to 585 feet of drift and rock. The company's borings have tested the deposit a distance of about 3,000 feet by four drill holes on a line east and west on the south side of the swamp, and latterly 800 feet by other drill holes to the north and south of the former. These investigations show the deposit to be a synclinal trough, having an inclination to the east of about 1 to 8. Upon the rise of ground north of the swamp, which intervenes between the seat of these new operations and the old workings, two shafts are sinking, 750 feet apart east and west, following the two most central drill holes. These shafts are descending vertically; the easterly one, "A" shaft, is 10x14 feet inside the timbers, and is being divided into two departments, is lined up with pine timbers, sawed, 12 inches square. The shaft is now down 375 feet, and has but 82 feet more to descend to strike the ore. No important difficulties are met with here; the water is raised by a succession of Knowles' pumps to within 35 feet of the surface, and thence flows through an adit to the south and empties into the swamp. The amount raised is about 320 gallons per minute. A shaft house has been completed over the shaft. The cost of the shaft has been thus far $100 per foot. In sinking "B" shaft much difficulty is experienced; in fact, the work is suspended from inability to proceed. The shaft, 12 feet square, was carried down 41 feet, when the quick sand coming in so rapidly from below as to preclude further progress, an iron caisson, 10 feet in diameter, was sunk inside the shaft, which was got down 72 feet; but the workmen have not been able to get within 10 feet of the bottom, as the sand comes in as

fast as it can be removed. A pump capable of removing 1,500 gallons per minute has been ordered, and when got to work it is hoped they will be enabled to proceed. These shafts will intercept the ore in the lower axis of the fold, and will be connected by a drift from which the vein may be stoped indefinitely either way, affording, probably, a far greater quantity of ore than the mine has ever yet produced. A large stone building is erecting, and is nearly enclosed, for the reception of the machinery. It is located at the lowest point of land between the two shafts, but a short distance from a small lake that lies to the north and only 12 feet above it, giving easy accessibility to water for the low pressure engines which are to be put in.

The engine room is 54x96 feet inside, and in it will be erected two engines (Hodge's), 28-inch cylinders, 36-inch stroke, one for hoisting and one for pumping; two drums, each 8-foot diameter and 7½-foot face, capable of holding 2,000 feet of 1½-inch rope. The water will be pumped up both the shafts from the sumps at the foot.

The compressor room is 36x45 feet, to be occupied by the Rand duplex 16x36 inch compressor. The boiler room is 36x55 feet.

The ground from the shafts slopes to the south to the level land below, where the railroad track will be built, affording excellent advantages for stock piles, ore pockets, etc.

In and about the old mine 90 men are employed, and there are two working shafts. No. 3, the most westerly one, is down to the eighth level, 400 feet below the surface on the line of the shaft, which inclines to the south at an angle of 60°. Descending to the bottom, we find at the end of the drift, 40 feet west of the shaft, what is stated by Capt. Sedgwick, the best stope ever afforded in the mine; it is of good width, entirely unmixed and is gaining as it descends. One thousand tons per month were being removed here until the work was somewhat interrupted by the necessity of having a pillar, which they are now working around. They are also sinking in the ore for another level below and are assured of at least 100 feet of extent of ore to the west. To the east of the shaft in this level the lense of ore soon become too narrow to pay for working. Above this level but little ore that can be profitably worked yet remains in the mine. Ore is being taken from several points, chiefly in the fourth level, but at small profit and soon to be exhausted.

No. 2 shaft, sunk in the jasper north of the ore, leads down into an immense chamber, said to be the largest on the lake—made by extracting the ore and rock. It has a vertical height of 120 feet, and a length and breadth of 100x40 feet. It is really divided in two chambers which are connected by an immense arched opening. In the western end of this level the company are mining, following the hanging wall, which is but a short distance from the Lake Superior Company's line. This line crosses the east end of the chamber and has been overstepped by the Barnum Company in its previous workings. Another level is also sinking in the bottom of the chamber; hand drills only are used. To the east we can pass directly into the Lake Superior mine where we find an immense stope of ore to which the Barnum has been obliged to bid adieu.

Capt. Wm. Sedgwick, the gentlemanly and efficient superintendent, estimates the product for the ensuing year at 20,000 tons.

The ore is selected with great care and is all first-class. It requires the closest scrutiny in examining the stock pile to find a specimen mixed with rock.

PITTSBURGH AND LAKE ANGELINE.

This mine is pleasantly situated on the south shore of Lake Angeline at the foot of the high greenstone ridge, which rises to the south. The mine openings extend east and west along the foot of this ridge a distance of about 900 feet, and but for the bars of ground which divide the opening into three compartments, would constitute a single pit.

There are no underground workings. The hoisting is done by three derricks worked by steam power and winding drums, and on an open skip worked from the main pumping and hoisting engine. A vertical shaft is sunk in one of the bars of ground that divide the pits, but is used only for the water pipes—all the water from the mine being raised through this shaft.

The mine has been regularly worked since 1863, and has shipped, in the aggregate, upwards of half a million tons of hard and soft hematite ore of medium quality. The product of 1880, however, was 5,000 tons less than that for 1864, and for the ensuing year the product will scarcely be increased. An exploring shaft was sunk in the meadow 200 feet east of the present workings, to a depth of 111 feet, and from the bottom drifts were run to the north 40 feet and to the south 30 feet. This work developed the existence of a good deposit of hard, blue colored hematite ore, apparently of an excellent quality; but the depth being so great it became a question whether it will pay to mine it.

The company employ at the present time 50 men.

The machinery comprises one main hoisting engine, 14 inch cylinder, 28 inch stroke, working two 4-foot drums; a pumping engine, 10 inch cylinder, 20 inch stroke, working a Cornish pump, 10 inch plunger; also two small engines for working the derricks.

There are about 30 dwellings and other buildings on the location. The description of the property is the N. $\frac{1}{2}$ Sec. 15, T. 47, R. 27, and is located about half a mile from Ishpeming. The officers are Joseph H. Outhwaite, Secretary and Treasurer, Cleveland, Ohio; A. Kidder, General Agent, Marquette, Michigan; Capt. Harvey Diamond, Superintendent of the mine, Ishpeming, Michigan.

THE SALISBURY MINE

is owned and worked by the Iron Cliff Company, and is situated in the north half of Sec. 15, T. 47, R. 27. The location lies directly south from the Pittsburgh and Lake Angeline, from which it is separated by a high greenstone ridge that intervenes. The mine workings comprise two open pits, and a few underground drifts. The east pit is 140 feet in depth in the deepest part, and below this bottom a distance of 70 feet, is a tunnel 207 feet long, connecting with the shaft south of the east end of the pit. The shaft is sunk vertically in the hanging wall, and extends below the mine workings so as to collect the water of the mine, which is pumped up through this shaft. The shaft is also fitted with a skip and used for hoisting. At the west end of the main pit an open skip road comes up to the south side, and No. 2 pit to the west, which is much shallower, is provided with a derrick for hoisting in buckets, worked with wire rope and winding drum. On a level with the bottom of No. 1 pit, a tunnel in the vein extends west beneath No. 2 pit, and the ore which is mined at this point is trammed through the tunnel to the open skip. From the tops of the two skip roads the ore dumps into deep pockets beneath which is the railroad track; they are also connected by an elevated track which extends east, with

two branches that run, the one to the rock dump, and the other to the winter stock pile. In the process of mining an immense amount of waste rock has been removed. Captain Bartle's plan for the future is to leave this waste rock in the mine to fill up the places where the ore has been removed; that is, to sink a 100 foot, and then by over-hand stoping remove the ore, and drop the rock, proceeding until the stope is exhausted, then sink again and proceed in like manner. The walls are poor, and the ore is a soft hematite, shoveling like dirt, so that the process of underground mining is not an easy one.

The vein dips to the south at an angle of about 60°, and is apparently from 30 to 50 feet wide. It narrows to the east, but widens out to the west, and runs to land somewhat to the south, and perhaps takes a more southerly direction after leaving No. 2 pit, but beyond that point it has not been much explored.

The pumping engine is a 16 inch cylinder, 2-foot stroke, working a Cornish pump, 12 inch plunger, and 12 inch drawing lift. The hoisting engine is a 16-inch cylinder, 30 inch stroke, and the winding gear comprises two 5-foot drums, and two 4-foot interior gear drums. Two 14-foot boilers, 72 inches diameter, supply the steam.

The mine was opened in 1872, and the maximum product, thus far, was shipped in 1878, consisting that year of 52,155 tons, two and a half times greater than the output of the mine in 1880.

NATIONAL MINE.

The National Mining Company have two openings which they are now working, distant from each other, east and west, about 1,200 feet. No. 5, the northerly pit, is looking exceedingly well; the bottom, which is 100 feet below the surface, is widening out to the east, so that a drift 18 feet long in the ore extending to the south, has not yet reached the hanging wall. The deposit is, apparently, 50 feet in thickness, very pure, hard granular ore. The vein dips to the south at an angle of about 70°, and following the foot wall down to the bottom of the pit is the skip road on which the ore is hoisted to the surface and thence trammed to the shute at the edge of the hill, beneath which is the railroad track, the conformation of the ground being very convenient for disposing of the ore and the rock. A new engine, 16 inch cylinder, 30 inch stroke, operates the two five-foot drums (only one is used), and does the pumping. Sixteen miners are employed in this pit, and there are at this end of the location 20 good dwellings. The course of the vein at No. 5 is east and west, but a little to the west the formation bends around and assumes at the south a direction north and south, the vein dipping to the west at an angle which gradually flattens until it becomes only 15 degrees.

In the open pit here the vein has been all worked out and the mining is now being prosecuted underground, having reached a distance of 400 feet, measured on the incline. The length of the stope is about 100 feet, and the height, being the width of the vein, is 12 to 14 feet. The product is a hard steel ore. Twenty miners are employed in this pit, and they are hoisting 50 skips per 24 hours.

Just west of this pit is another one, which has been nearly worked out; but three men are scramming about five tons per day in it. The mine is worked under a lease from the Lake Superior Iron Company, to whom the land belongs. It is embraced in section 16, T. 47, R. 27, and the lease covers 240 acres, being one and a half miles south from Ishpeming. Work was begun in

1878, and the aggregate product, as shown in the table of shipments, is nearly 67,000 tons.

The mine is under the general supervision of Captain Samuel Mitchell, of the Saginaw mine, who is also one of the lessees of the estate. The local superintendency is in charge of Capt. Williams, an experienced miner.

THE MITCHELL MINING COMPANY

is an organization which was formed and began work in 1877. The estate adjoins the National on the southwest, and comprises 200 acres in Secs. 21 and 28, T. 47, R. 27. A mine had been previously opened on the same location, under the name of the Shenango, in 1872, and operated until the organization of the new company. The former workings, however, have been entirely abandoned, and the pit which had been formed has been filled up by the debris removed from the new opening further to the east.

The present mine workings comprise a large open pit, 100 feet in depth, running east and west with the direction of the vein, which dips to the north at an angle of about 45°. Near the middle of the south side of the pit a skip road ascends to the ore pocket above the surface, and at the east end is a shaft which descends to a depth of 40 feet below the bottom of the pit. At the foot of this shaft is collected all the water which makes in the mine and through it the water is pumped to the surface. It is also fitted with a skip road and used for hoisting the ore taken from the level below the bottom of the pit. In this lower level a drift extending to the west will be used to take out this bottom.

Drifts have also been run from the shaft to the north 100 feet through soapstone where a vein of good ore was intersected, but it was not penetrated far enough to determine its width. A similar drift to the south at a distance of 93 feet from the shaft also intersected a fine vein of ore, and along the foot wall of this vein a tunnel 14 feet in width has been opened to the east a distance of 350 feet from the point of intersection.

A shaft has been started from the surface to meet this tunnel, and in sinking passed through 70 feet of dirt and then in the ore which it has now penetrated 30 feet. This ore is remarkably clean, a very fine quality of soft blue hematite, an analysis showing it to be very high in metallic iron and low in phosphorus and in silica. The extent of this rare deposit, however, is undetermined.

In this mine there is no rock capping the ore, the veins being directly in contact with the drift which overlies to a depth of 70 to 80 feet. The ore itself has very little more sustaining force than good dirt, so that in the process of underground mining unusual care will have to be taken to hold up the ground. Capt. James Walter, the local superintendent's plan, is to run a tunnel along the hanging wall corresponding with one along the foot wall, and to cross-cut between them at sufficient intervals to form supporting pillars which he proposes to stay with stulls thickly set about each of them and banded, or with timbers laid horizontally and locked at the corners forming a crib, having also a thick back to the level.

The company is now employing 65 men in and about the mine, and has about 20 houses on the location. The machinery embraces a new engine, three 4-foot drums, Lane's pattern. This engine does the hoisting and the pumping. The officers of the company are Samuel Mitchell, President; Chas. Merryweather, Secretary and Treasurer.

THE WINTHROP HEMATITE COMPANY.

The Winthrop mine lies in close proximity to the Mitchell, joining the latter on the west. The property embraces the S. W. ¼ of Sec. 21, T. 47, R. 27, and the mine was originally opened in 1870 and worked until 1877 by the Winthrop Iron Company, under a lease by Messrs. A. B. Meeker and H. J. Colwell. In the latter year the lease was transferred to the St. Clairs, who organized the Winthrop Hematite Company, and have since operated the mine under that name.

The mine, as will be seen from the tables, has yielded an aggregate product of nearly 213,000 tons of ore, which, like that of the Mitchell, is a very soft hematite.

The mine consists of a very large open pit, the bottom of which is 180 feet below the surface, and somewhat extensive underground workings beneath and to the north and west. The lowest level is 220 feet down. From the open pit at the height of the third level, two drifts have been extended to the north a distance of 80 feet, and connected by a cross drift 90 feet long, all in the ore. There seems to be several veins or lenses lapping each other or only slightly separated by the intervening rock which occupy the ground from the foot wall to the north for a considerable distance. These veins or lenses dip to the north at an angle of about 60° and their continuity in depth together with their great lateral extent affords a large amount of stoping ground. Two open skip roads on the east side of the pit, and a double skip vertical shaft a short distance from the west end, afford the channels for hoisting.

A large quantity of timber is used for supports in the mine. The ore being so soft it is deemed to be of but little use to leave it for pillars. These timber supports are made up into 12-foot cubical sections, and are so numerous as to furnish, it is thought, the requisite degree of safety.

There are two engines at the mine—one upright and one horizontal, supplied with steam from three boilers. There are three 4-foot winding drums and two 3-foot. Railroad connection is afforded here and at the adjoining locations with the M., H. & O. and with the C. & N. W. main lines. The employés number 130 men and the location contains 35 houses for the occupation of themselves and their families. The officers are J. O. St. Clair, President; E. G. St. Clair, Secretary and Treasurer; G. A. St. Clair, Superintendent.

THE LOWTHIAN AND NEW ENGLAND MINES

are owned by the Lake Superior Iron Company. The latter comprises the E. ½ of the N. W. ¼ of Sec. 20, T. 47, R. 27, and was worked from 1866 to 1873, producing an aggregate product of 110,506 tons of ore. Since the latter period it has remained idle. Adjoining it on the east is the Lowthian, which is now working. The mine consists of a large open pit 250 long and 100 feet wide on the surface, and 80 feet deep; below this bottom extend two underground levels of 40 feet and 80 feet respectively, and the shaft which is sunk from the lower level of the skip road is down 120 feet below the bottom of the pit. The ore in the 40-foot level, below the bottom, is worked out, and the mining is now carried on in the 80-foot level, and in a few days will also be inaugurated in the 120-foot. The vein dips to the north about 40°, and has a width of about 50 feet in the 80-foot level, where it has been opened a distance of 150 feet. About one-half of the width of the vein is good hematite ore; the north half, against the hanging wall, is a mixed hard ore and is not mined.

The machinery consists of a hoisting engine 18 inch cylinder, 32 inch stroke, two five-foot winding drums, Lane's pattern, and an inadequate pumping engine 12x18 inches, which is soon to give place to one of larger calibre. The mine furnishes employment to 80 men. The location is but a short distance west from the Winthrop.

SAGINAW MINING COMPANY.

This mine is situated on the N. W. $\frac{1}{4}$ of the N. E. $\frac{1}{4}$ of Sec. 19, T. 47, R. 27. Other contiguous lands are also embraced in the company's estate. The mine was opened by Messrs. Maas, Lonstorf and Mitchell in 1871, who in the following year sold out their lease for $300,000 to parties who organized the Saginaw Mining Company, since which time the product has been in the aggregate 389,981 tons of ore.

The mine was thoroughly examined by the commissioner in 1878 and described in considerable detail, in his report of that year, and there is little to add to the facts therein recorded. The mine, that originally extended 1,000 feet, with four working shafts, has gradually become circumscribed to a single available pit at No. 2 shaft, which is down 500 feet from the surface on the lay of the vein. The vein is here about 12 feet wide, and is opened so as to afford some good stopes for mining the ore. The great difficulty which has always been met with in this mine, regarding the water, is now somewhat intensified from the fact that the whole mine has to be kept free from water in order that the one pit may be worked. The mining plant, which was ample when all four of the shafts were working, is naturally in excess of present requirements.

The vein has a variable dip of from 40° to 50° to the north. The ore is an excellent quality of specular, containing some magnesia. Upon the location are 110 dwellings, several stores, a saw-mill, etc. The officers are Henry Chisholm, President; S. H. Chisholm, Secretary and Treasurer; Samuel Mitchell, Superintendent.

Adjoining the Saginaw on the east is the Lake Superior Iron Company's

SECTION 19 MINE,

which is now worked under a lease by the Saginaw Company. The description of the land which this mine embraces is the N. E. $\frac{1}{4}$ of the N. E. $\frac{1}{4}$ of Sec. 19, T. 47, R. 27. It was opened in 1871 by the Lake Superior Company, and continuously worked by that company until leased to the Saginaw in 1879. There are two working shafts, No. 1 near the Saginaw line, and No. 2, 480 feet to the east. The workings are now down about 300 feet on the lay of the vein, which dips to the north at an angle of about 50°, and has an average thickness of about 14 feet. The mine has all the appointments for successful working, and yields a rich, granular ore, containing a percentage of alumina, as can be readily seen with the unaided eye.

In the two mines the company employ about 170 men. The location is three and a half miles south of Ishpeming, and one and a half miles from the main line of the M., H. & O. R. R. It is also connected with the C. & N. W. R. R.

GOODRICH MINE.

The most westerly mine in the Saginaw range is the Goodrich, which joins the Saginaw on the west, the description being the W. $\frac{1}{2}$ of the N. W. $\frac{1}{4}$ of Sec. 19, T. 47, R. 27. The mine was opened in 1873 by the St. Clair brothers,

but who soon after abandoned it, when the property was purchased by its present owner, Captain Goodrich, of Chicago, who has since continued to work it with indifferent financial success. The total shipments to the close of 1880 aggregate 31,361 tons, the product of the latter year being more than one-third of the total amount. Capt. Henry Davis, the present superintendent, is determined to make a reputation for the mine, and apparently he has the ability to do it if there is in the mine the material to respond to his efforts. The workings comprise three open pits running northeast and southwest, and a tunnel through the hill from the east enables the ore cars to run directly into the mine; the winter product, however, is run up the skips to the stock pile above. The formation is very irregular and the ore is peculiar. A greater development will be necessary to enable one to form an opinion of the value of the mine.

NEGAUNEE RANGE.

THE MILWAUKEE MINE.

The mine attracting the most attention at present is the Milwaukee, located on the southeast quarter of the southwest quarter of section seven. The leasehold was owned by Messrs. J. Q. Adams and James F. Foley, who recently sold their interest to the company now operating the mine. The officers of the Milwaukee Iron Company are: President and Treasurer, R. S. Fay, Esq.; A. Kidder, Agent; Jas. F. Foley, Esq., Superintendent.

This mine, though less than two years has transpired since ore was first discovered on the property, bids fair to take the lead of the soft hematite mines of the Marquette iron district. A great change has been wrought within the past year. Then there was only one small building, the engine house, on the location, and mine proper consisted of two shafts. No. 1 shaft, the westerly one, was 95 feet deep with drifts driven to the east and west from the bottom respectively 65 and 50 feet in length. No. 2 shaft was 35 feet deep with a short cross-cut to the south. The ore in No. 1 shaft at present (March 28) appears to be the bottom portion of a lens. It is 110 feet long and 95 feet deep, and nearly pinches out at the ends and in the bottom. Captain Foley describes it as resembling a birch-bark canoe with the sides almost squeezed together. It was 23 feet wide at its strongest point. At No. 2 shaft we have an open pit 80 feet long east and west and 70 feet wide, by 80 feet deep. On the west of the pit is a stope of soft blue and gray ore 40 feet wide and 60 feet high. To the east side the ore is 30 feet wide and 30 feet high from the bottom of the pit. Near the center of the east half of the pit a winze has been sunk 29 feet deep, but within a very short distance the winze came upon chloritic schist which continued all the way down. From the bottom of the winze a drift is driven 45 feet to the north in chloritic schist; another to south 35 feet; the first eight feet was in chloritic schist but the remainder of the distance was in mixed ore and jasper. The east half of the bottom of the pit is ore. From the bottom of the pit a drift has been driven 115 feet to the west, which was all in ore except one short run of chloritic schist. Thirty feet above this point another drift was driven 65 feet to west, which was also in ore. From this it appears probable that the lens of ore in No. 2 laps on to the south side of No. 1 deposit. A branch from the M., H. & O. R. R. extends past Nos. 1 and 2 ore pockets. The skips at these shafts are at present operated by two of Merritt's internal gear 30-inch drums, though I understand it is the intention to put in two four-foot drums and use the smaller ones for the north side workings.

Six hundred feet to the north and 100 feet to the east of No. 2 shaft is the

No. 3 or Ryan's pit. Ore was discovered here last summer by some children digging into the side of the hill in imitation of the miners. The result was not only a large find of ore, but a new suit of clothes for each of the juvenile company, presented by Messrs. Adams & Foley. The Ryan pit is located on the south slope of a side hill, while Nos. 1 and 2 shafts are near the base of the north slope of that side of the valley. The bottom of the Ryan pit is 25 feet above the M., H. & O. R. R. track. A tram road now connects the pit with the ore docks and pockets alongside of railroad track.

Passing now along the tram road we enter the Ryan pit through an open cut. The first that attracts attention to either side of the cut is a ledge of massive diorite, and then comes on the north side of the diorite a soft blue ore resembling the Vulcan of the Menominee range. An analysis of several samples of this ore, collected by Mr. A. Kidder, as an average, afforded as follows:

Metallic iron	61.090
Phosphorus	.098
Silica	5.200

To the west of the entrance is a shaft 30 feet deep. The first 25 feet of the shaft was in ore, but the remaining five feet was in rock. A portion of this ore was a hard velvety-textured specular, or hard hematite. This ore is very rich, as may be seen by the following analyses made by myself:

Metallic iron	68.14	68.90
Phosphorus	.07	.05
Silica	1.10	.67

From this point to the north side of the pit is over 100 feet. The strike of the formation is S. 80° W., and the dip is 45° to the south. On the south side of the open pit the gradual rise of the hill gives a stope of ore at the northwest corner of over 25 feet high. The breast of ore at this part of pit is about 30 feet wide; south of this point for some distance the west side presents a face of lean ore and decomposed chloritic schist. But only 12 feet west of the upper edge of the pit and inside of its rocky face, ore appears on the surface of the ledge, and a drill hole at this point 14 feet deep is all in ore. The face of the east side of the pit contains more rock and lean ore than the west side. The earth is stripped from the ledge for 25 feet south of the upper edge of the pit, and shows a large percentage of ore all the way across.

Two hundred and fifty feet northwesterly from the Ryan is No. 4 pit or cut. The present level of this cut is 30 feet above the main railroad track, or 15 feet above the bottom of the Ryan pit. The present work in this cut is chiefly confined to removing the earth from the ledge. Tram cars are used to transport the dirt to the dump. It occurs to me in glancing over a sketch of the location that it would have been better to have started the No. 4 cut on the same level as the Ryan pit. This would have given a higher stope of ore to the north and uncovered the ledge lower down the side hill. It would also have avoided the possibility, in part at least, of dumping the stripping on what might be a ledge of ore, which I apprehend will be found to be the case. No. 5 cut is 230 feet southwest of No. 4. It is 20 to 25 feet above the main track. The cut has just struck the south edge of the ore. About 50 feet southeasterly from where ore was found in No. 5 a test pit was sunk and bottomed on diorite. This diorite is the same as that already noted at the entrance of the Ryan pit. The diorite has also been found in another test pit midway between these points. It is interesting, as it appears to form the hanging wall of this ore. The trend of the diorite is about the same as that of the plainly bedded ore. To the west

of No. 5, but on a higher level, and to the east between No. 5 and No. 4 cut, and between No. 4 and the Ryan pit, are three other cuts used for stripping the earth from the ledge. Tram cars are also employed in these to move the dirt to the dump on the south slope of the hill. One evil feature, as before remarked, is the possibility of having to remove these dump piles. Besides these pits and side hill cuts, numerous test pits have been sunk which partly proves the ore bearing belt to be from 150 to 200 feet in width and more than 500 feet in length. In this belt, however, are horses of rock, but what proportion they bear in the aggregate to the ore is impossible to say.

The present outlook of the new find is certainly good, and the ore after the earth is removed can be mined very cheaply.

East of the Milwaukee mine on the adjoining forty is the main opening of the

ROLLING MILL MINE, (APRIL 10th, 1881).

The main workings of this mine consist of a large open pit shaped in the form of a horse shoe. It is about 100 feet wide and probably 400 feet around the bend. The convex side of the bend lies to the south, and the end of the arms therefore are to the north, which gives an east and west trend to the pit. From the west arm, in going around to the east, the bottom of the pit descends so that the north half of east arm is 200 feet below the original surface. The bottom of the pit is looking very well at present. The vein of soft hematite appears to be narrowing and ore at certain points is becoming somewhat mixed. In the east side face, at the bottom, they have driven a drift in that direction for 150 feet, and have stoped out the vein which varies from six to eight feet wide for 30 feet above the drift. To the southeast is another small opening, but the ore from it is more or less mixed. On the whole the present outlook of the mine is not very good, still I cannot believe that the first-class ore has all been mined out in this mine. A few diamond drill holes would be of great value to this mine. Capt. George Berringer, an old and experienced miner, has been working the mine for the past two years under a lease, and was he fully assured of a long, undisputed lease of the mine I have no doubt but that he could very soon greatly improve the prospects of the mine. The mine has a good plant of machinery consisting of boiler, a large engine and three 4-foot drums, one of them being Lane's patent external friction.

THE CHICAGO MINE,

so called, is situated in the southeast corner of Sec. 7. The lease held by Mr. J. F. Stevens and W. C. Calhoun, the proprietors of the mine, covers the S. $\frac{1}{2}$ of the S. E. $\frac{1}{4}$ of that section. The work now in progress is being prosecuted in the bottom of an open cut at a depth below the surface of about 80 feet. This pit has a vein of soft brown ore of the color and apparent texture of rotten stone, greatly mixed with jasper so that the ore has to be picked out piece by piece. In this manner several thousand tons have been selected, of ore of a medium quality.

In the bottom of the pit at the southeast corner has appeared a vein of a much softer ore and of better quality. The owners are naturally anxious that this small beginning shall develop into a deposit of magnitude.

A small engine does the work of hoisting and pumping. Thirty men are employed.

McCOMBER MINE

was opened in 1870 by W. C. McComber, Esq., who obtained a lease of the property from J. P. Pendill, Esq., the owner of the land. In 1872 Mr. McComber disposed of his lease to the McComber Iron Company, which was organized August 14, 1872, capital stock $500,000 in 20,000 shares. The officers of the company are S. L. Mather, Esq., Cleveland, Ohio, President and Treasurer; Fred A. Morse, of same city, Secretary; and J. C. Morse, Marquette, General Agent. The mine workings are located in the N. W. ¼ of the N. W. ¼ of Sec. 7, and the S. W. ¼ of the S. W. ¼ of Sec. 6, T. 47, and R. 26. Two years ago Nos. 1 to 5 pits were all being worked, but to-day all but No. 5 are idle, a depth in the first four having been reached where open mining is no longer profitable and underground work will have to be adopted. There seems to be a strong aversion in the most of our soft hematite to change from open to underground mining. To do this is much more expensive than in a hard ore mine. Shafts and winzes must be sunk, levels driven, and roofs must be left the same as in hard ore, and in addition they are obliged to support the roof and overhanging ground by heavy timbers. But while the ore now raised at the McComber is taken from open pits, work is being carried forward with a view to underground mining in the near future.

Near the west line of the property a shaft has been sunk to a depth of 40 feet, which is now in the ore, and from the bottom a drift is being extended horizontally for the purpose of determining the value and nature of the deposit. Also 100 feet to the north of the engine house a shaft is now being sunk, having already reached to a depth of 140 feet from the surface. The sinking is now in the ore, the product being raised and conveyed to the stock pile.

When a sufficient depth is reached, levels will be driven and a system of underground stoping inaugurated.

While there exists more uncertainty as to the permanency of soft hematite ore deposits than with the hard ore veins, there is yet very far from being any signs for apprehension to be observed at the McComber.

Since scarcely at any period in its history has the mine appeared more favorable than at present, both as to quantity and quality of the ore and the cheapness at which it can be apparently mined. In No. 5 pit, in the west end, the vein is fully 25 feet in width and is almost entirely free from mixture of rock. In the bottom and ends of this pit the ore is very easily and safely mined and hoisted to the surface in iron buckets worked with wire ropes from the engine house. This pit is about 100 feet in depth.

Near the engine house, on the south side, a surface drift has opened an extensive deposit of soft hematite ore. This deposit is being mined as readily as from a clay bank, and shoveled into the carts that convey it over a short haul to the car shute.

At various points in the mine are revealed promising deposits of ore, sufficient to enable the McComber to continue to hold its place as one of the leading hematite mines of the Marquette district.

The mine is now producing a weekly product of about 900 tons; 50 men are employed. The plant is simple and inexpensive, but sufficient for the purposes required. Mr. W. G. Pollock, formerly of Cleveland, Ohio, has been appointed agent, and has recently assumed the charge of affairs.

TEAL LAKE RANGE (APRIL 1, 1881.)

From Negaunee we travel along the railroad track, leaving the main track about half a mile west of the railroad depot, on a branch track to the northwest, which leads to the Cambria, Bessemer, Forest City and Cleveland hematite mines. About one and a half miles from the depot we arrive at the

CAMBRIA MINE,

the property of the Cambria Iron Company. This property embraces the S. E. $\frac{1}{4}$ of the S. E. $\frac{1}{4}$ of Sec. 35, and W. fractional $\frac{1}{2}$ of Sec. 36, T. 48, R. 27. Ore was first discovered here in 1874 by R. P. Harriman, Esq., who leased the property from the Teal Lake Iron Company. In 1875 Mr. Harriman, associating himself with J. H. McDonald, John Q. Adams and Lewis Corbett, organized the Cambria Iron Company. The present officers of the company are W. H. Barnum, President; James Rood, Jr., Treasurer; John Q. Adams, Secretary; A. W. Maitland, General Manager. The past two years have wrought a few changes in the general appearance of the mine. The first working that we see as we approach the mine from the east is a long open cut, 350 feet east and west by 50 feet wide, and varying in depth from 75 to 20 feet. The formation here has an east and west trend and dips to the south at an angle of 45°. At the extreme east end of this opening the incline shaft, which the old company was sinking two years ago, was only carried down about 10 feet further where the vein nearly pinched out. Since that date, or within the past year, the new organization has driven down to the east of this shaft, under the east face of the cut for some 75 feet, and opened out a chamber in a lens of a fine quality of soft hematite ore. The chamber varies in height from 25 to 30 feet. To the east of this chamber is a drift near the roof driven some 20 feet still farther to the east. It looks now as if the ore was going to "make" in the bottom around to the west in front of the shaft. The ore to the west in the bottom of the long, open cut is more or less mixed with narrow runs of jasper and chloritic schist. It is the intention now to sink a shaft this season at the west end of the long, open cut, and to thoroughly explore this part of the mine.

About 300 feet westerly from the long, open cut, is another opening which was made in 1879. The opening is 90 feet long by, say, 40 feet wide and 40 feet deep. The ore of it is a soft hematite, but is hardly first-class. Still farther west, 100 feet, is a shaft which was sunk the first winter 26 feet deep. The first seven feet was through earth and remaining 19 feet is in a soft, shaly, bluish-colored ore, resembling very much the Vulcan ore of the Menominee range. An average of the ore from the shaft afforded:

Metallic iron	66.400
Phosphorus	.045
Silica	2.200

From the bottom of the shaft they have cross-cutted on ore, showing a total width of ore at this point of 39 feet. The vein widens to the west, but it is only 75 feet from the shaft to the west line of this property, or the division between it and the Bessemer mine.

The Cambria has now a new engine house, with an engine, boiler, and two three-foot V friction drums.

Adjoining the Cambria on the west is the mining property of the

BESSEMER MINE,

which comprises the W. ½ of the S. E. ¼ of Sec 35. Just at present the new find of the Cambria, above alluded to, which crosses the line into the Bessemer, is receiving considerable attention. Several test pits have been sunk to the ledge, which prove the ore thus far to have a length of not less than 116 feet west from the east line of the Bessemer, and a maximum width of 80 feet across the deposit. Preparations are being made to strip the earth from the ledge, so as to have a working stope by the opening of navigation. The ore is similar to that found on the Cambria, it being one and the same deposit. Seven hundred and twenty-five feet west of the new find, is the same open pit we examined and described two years ago, only that it is now down 145 feet below the surface. The pit is 120 feet long by 90 feet wide at the surface. In the east half, at about 90 feet below the surface, has been left a bench of ground and in the centre of it a well-timbered shaft is sunk to the bottom level. From the bottom of the shaft a drift connects with the open portion of the pit to the west. The drift is of good size and serves as a pump house, also as a safe outlet for the miners. The shaft no doubt will be eventually used for the purpose of changing from open to underground mining, which period, in the writer's opinion, has fully arrived. The soft hematite ore deposit is about 50 feet wide. The strike of the formation is about east and west, and the dip 50° to the south.

About 60 feet west of this open pit is another large open pit. This latter pit is 100 feet long by 80 feet wide and 120 feet deep in the west half and 80 feet deep in the east half of the pit. The ore in this pit is, at present, 30 feet wide at the bottom, but the hanging wall has not been reached. The west end of the pit is about 200 feet from the west line of the property. Both pits are worked by large derricks which are swung around to the dumping place by the engines. The present owners and operators of the mine are C. M. Wheeler, Esq., of Marquette, Mich., and J. H. King, Esq., of Painesville, O.

FOREST CITY IRON MINING COMPANY.

The location of this mine comprises 60 acres in the southwest corner of Sec. 35, T. 48, R. 27, lying between the Bessemer mine on the east and the Cleveland Hematite on the west, the mine openings being closer to those of the latter. Work was begun here in 1880, and about 500 tons of ore gotten out that year, when the lease was sold to Cleveland parties and the Forest City Iron Company organized in February last, with C. A. Otis, President; T. H. Brooks, Treas; F. A. Bates, Secretary, all of Cleveland, O., and Geo. R. Tuttle, General Agent, Ishpeming, Mich.

Mr. Tuttle began work soon after the organization of the company by sinking a line of test pits ten feet apart, from the south line of the property to the greenstone on the north. This work resulted in finding a deposit of ore a short distance south of the pit already opened, between it and the section line. The vein was uncovered, and early in May the work of mining the ore began with so favorable a result that before the end of the month 1,000 tons had been mined and shipped. The vein has been mined to a length of about 50 feet and to a depth of about 15 feet. It has hardly been sufficiently exposed to determine its extent, but the width at which it is worked is about 10 feet, with indications that what has been regarded as a foot wall is simply a thin covering of jasper, rock, beyond and under which the ore continues to the

north. The west end of the opening looks much the most favorable, and to the south the work is limited by the boundary line, in contact with which is the south side of the pit. The dip is to the south at an angle of perhaps 50°, there being, apparently, little regularity in this respect. No. 1 pit, a little to the north, is not worked out, there being a fair showing of ore in the west and south sides, but the water has come in freely, and there being no pumping machinery at work, it became necessary to await the erection of an engine and pump. From the bottom of this pit a tunnel 30 feet long running westerly intersected a pocket of ore which was mined out and hoisted to the surface through a winze. This work was done before the spring break-up, after which the water made too freely. If the ore in No. 2 pit shall appear to underlie to the north it is the intention to strip the ground between the pits and expose it to surface mining.

Where so little is known it is scarcely safe to conjecture, but is undoubtedly better to proceed cautiously, as Mr. Tuttle seems to be doing, until he becomes more sure of his ground, when he can go forward and perhaps avoid useless expenditure.

The company has, as yet, very little surface plant; a small engine to hoist the buckets to the surface and a larger engine not yet erected constitute the machinery. Mr. Tuttle hopes to get out 20,000 tons the present season, and if the mine maintains its present favorable outlook he will doubtless succeed in fulfilling his expectations. The ore is a fair quality of hard and soft hematite, yielding, if carefully graded, 60 per cent in metallic iron, and being low in phosphorus, finds a ready sale.

CLEVELAND HEMATITE,

located on Sec. 2 is the most westerly of the Teal Lake range of hematite mines, the Bessemer, the Cambria, etc. It has heretofore been worked on a lease by Mr. R. Nelson, of Ishpeming, but since May, 1, 1881, has been worked by the Cleveland Company, to whom the mine belonged, and who have purchased of Mr. Nelson the mining plant, etc. The mine yielded about 18,000 tons of ore the past year. The company is now engaged in sinking diamond drill holes south of the M., H. & O. R. R. track, near the superintendent's house. Six holes have been bored and they are now engaged on the seventh, in which latter they have just struck ore at a distance down of 300 feet. The holes have all been bored since January last, and are from 400 feet to 450 feet in depth. In two of these holes, 105 feet apart, ore has been found, at distance down of 308 feet and 215 feet, respectively, of a thickness of 56 feet and of 60 feet; of this 37 feet is first-class ore in the one hole and 52 feet is first-class in the other. In one of the other holes 15 feet of ore was found. It is the intention to commence sinking a shaft here as soon as a point can be fixed upon which the ore comes nearest to the surface. Further exploration with the diamond drill will be made to the west and south of No. 3 pit during the coming summer. This work is done on company account. A new pumping engine house will be erected also this coming season, furnished with new machinery, which will run one pump in the incline pit and one in No. 3, and one set of wire rope pumps in No. 6.

REPUBLIC IRON COMPANY.

This company enters this season upon its tenth year of shipments. It was organized October 20, 1870, capital stock $500,000 in 20,000 shares, by S. P. Ely, Hon. Ed. Breitung and E. D. Parsons.

The mine is located in Sec. 7, T. 46, R. 29, and is nine miles southwesterly from Humboldt, on what is known as the Republic branch.

In our report of two years ago, of this mine, we described its geological and topographical features, as follows:

The ore stratum, as well as the associated overlying quartzite and underlying ferruginous schists and massive greenstone strata, originally horizontally bedded, have, by lateral pressure from the northeast and southwest, been sharply folded, while subsequent glacial action and other agencies have worn away, above a certain horizon, the entire iron bearing series, leaving us the remaining strata, with their upturned edges, apparently bent in the form of a large oxbow, the arms of which have a northwesterly trend—the bend or bow being at the southeast side.

Possibly we can more clearly understand how this present structure was brought about if we will suppose the Huronian strata we are now considering, and the underlying granite to have been bent upwards by lateral pressure. It is plainly evident if a weak line existed in the granite stratum, for any distance, that our arch would naturally bend sharply downward along this line, and should this line of least resistance suddenly terminate there would occur a trough like depression, which would become more apparent if the overlying strata were worn away down to the granite. This condition we have already assumed in the first example.

Returning to our oxbow, we find its northeast side or upturned edge dipping nearly vertical, except at the southeast end, where it dips about 60 degrees to the northwest; the prevailing dip or inclination of the strata is towards the center of the trough. The trough extends northwesterly about eight miles, where its sides rapidly diverge from each other; its average width for this distance is less than a mile from outside to outside. The Michigamme river follows along the basin of this trough, and at the Republic mine widens out into a beautiful bay. The arms of the bow at this point are about one-half mile apart. The mine workings are located on the north arm and at the lower end of the oxbow, and extend altogether, on the course of the vein, about three-fourths of a mile.

The ore stratum has for its hanging wall proper a massive gray quartzite, similar to that of nearly all our hard ore mines, while the foot wall is banded jasper. The mine is divided into fourteen pits—numbered from one to ten; the remaining four are known as the Gibson, Ely, Morgan, and Perkins.

We will now proceed under the careful guidance of Captain Pascoe, and make the "grand rounds" of the Republic mine, which, to-day, is second to none of the larger iron mines of the world.

We will begin with No. 10 pit, not because it is the most important opening, but that it happens to be the first one in our way as we approach the mine. Before entering the adit leading into No. 10 pit, which is 67 feet above the water in the bay,* we will tarry a moment to take a general view of the "location." To the northeast the ground rises rapidly, and within 200 feet is the bold face of the Jasper bluff, which, in the sunlight, sparkles with countless scales of specular ore. The range terminates abruptly to the northwest in a

* Water level in bay is 914 feet above Lake Superior.

few hundred feet, but to the southeast it continues for more than 1,000 feet in a fairly straight line, embracing in its course Nos. 10 to 4 pits inclusive. The formation within these limits has a strike of N. 50° W., and dips to the southwest or towards the bay at a high angle, which is only slightly inclined from vertical. From No. 4 pit the formation curves rapidly to the southwest, west, and even to the northwest, but the ore stratum, as well as the underlaying rocks, seem to have resisted the force that turned them from their course, and in several instances we notice sharp, contact folds of the ore vein into the foot wall, the banded jasper conforming to these spurry folds. The line, therefore, of our ox bow, as already noticed, is not regular, but is very crooked at its southeast end.

About 100 feet southwest of No. 5 shaft is the main engine house; from it are operated a skip in No. 7 shaft, a double cage lift in No. 5 shaft, and No. 3 skip road. In the engine house building is the machine shop, where all necessary repairs of the power drills and other machinery are made.

To the west, say 100 feet, is the engine house for the pumping engine, which raises the water from the fourth level to the surface of Nos. 7 to 3 pits, inclusive. To the southwest about 1,000 feet more may be seen the several masts and guy ropes of the derricks of the open Pascoe pit, reminding one of a small ship yard. Southeast of the Pascoe pit only a short distance is a building which contains a hoisting plant of four six-foot drums of "Merritt's patent internal gear." The plant is a fine one, and will doubtless accomplish all that is required of it. West of this, say 200 feet, is another building in which is placed a large pumping engine, similar to that just noted, which will raise the water from the Ely, Pascoe, and Morgan pits.

Laid along the general line of the pits is a boiler-iron pipe 15 inches in diameter, painted red, which conducts the compressed air from the compressors to the hoisting engines, pumping engines, power drills, etc. The compressors are located on the Michigamme river, below the bay, about one mile southwest from No. 5 shaft. At this point is a fall, altogether, of 16 feet in the river, which drives two of Swain's 66-inch turbines, which in turn operates four compressing cylinders, two feet in diameter by five-foot stroke. The power of the turbines with the 16-foot head of water is rated at 700 horse power.

The original outlay of this pneumatic plant was large—$100,000; but its advantages are great. The success of the undertaking is entirely due to Mr. David Morgan, the president of the company, who personally supervised the putting in of the plant, and construction of the accessories from first to last. In front of the pits may be seen the trestles upon which are laid the tram roads that lead towards the bay to the large stock piles of ore and ore pockets, or to the waste dumps of rock, while along in front of the stock piles and ore pockets curves around on a slightly ascending grade, the main railroad track with its diverging branches leading into the different openings. Below this, still nearer the bay are the dwellings of the miners, the company's offices, warehouses, wagon and smith shops, barn, etc., and below these again skirts the shore of the bay, beneath which, down into the unexplored depths of the bedded rocks, will probably be found the continuation of the Republic vein, where the miners, no doubt, at some future will be drilling, blasting and sending ore to the surface.

Having now taken a hasty glance at the location on the surface, and wondering our outcome from ways that are dark, we place ourself again under the

careful guidance of Capt. Pascoe, and pass into the adit of No. 10 pit. This adit is driven 200 feet northeasterly into the side of the hill, cutting through the hanging wall of gray quartzite and intersecting the vein of ore about 75 feet below the outcrop. The vein here is narrow with quartzite on the foot wall side. The adit at this point divides, or rather a branch of it leads to the right along the narrow vein of ore for a short distance, where the vein widens out to ten feet. At this point they have stoped out an open place 50 feet long by 50 feet deep. The main adit is driven through the apparent foot wall of quartzite, and within a few feet intersects another narrow vein of specular slate ore, averaging less than six feet wide. The point of this spur of quartzite is to the southeast where it divides the vein of ore; it is over 500 feet in length, but it will probably cut out as greater depth is attained.

Geologically this double lock split or spur of quartzite into the ore vein possesses much interest, but practically, to the miner at least, its features are decidedly of a negative character.

Southeasterly from No. 10 adit we pass the mouth of No. 9 adit. No work is being done here at present, but during the past winter a party of scrammers* have taken out a small stock pile of ore. The vein in No. 9 is narrow but bids fair to widen further down. We will pass it by and enter No. 8 adit. The sole of this adit is 72 feet above the bay. No. 8 pit is mined out to the second level or 130 feet below the adit. On the northwest side it is stoped out for 110 feet from the shaft. The roof comes down from just above the adit on a northwesterly pitch, which apparently corresponds to that of the vein, that is, the vein is gradually widening as they go down, but the parallel lines of a plane intersecting the foot and hanging walls of the ore vein have a steep northwesterly pitch. They are now sinking the shaft to the third level. To the southeast on the second level it is 263 feet to No. 7 shaft, and the ore from this level between the shafts is all stoped out to the surface with the exception of the supporting pillars. Eighty feet southeast of No. 8 shaft they have cut through the jasper horse, on the hanging wall side, and into a six-foot vein of specular slate ore, but have not proved it up. This is the same jasper horse we noted two years ago. The floor of the second level for 15 feet down will be left to form a roof for the lower levels. To the northwest of No. 7 shaft, just before reaching the limit of this pit with No. 8, is a winze sunk in a deposit of ore which lies apparently within the foot wall. On either side of No. 7 shaft, are left pillars of ore which will extend from level to level with the exception of archways cut through at the sole of each level. Southeast of No. 7 shaft the vein is mined out from second level to outcrop. Descending now 45 feet to third level, which is 100 feet below the bay, we find a drift 70 feet in length driven to the southeast; 35 feet from the shaft the drift branches to the left and passes around the northwest point of jasper horse. This is the same jasper horse we described two years ago, 75 feet above the third level. It was then 100 feet from the shaft, but the northwesterly pitch brings it nearer the shaft at every level as we go down. The vein of ore varies on either side of the jasper from four to seven feet in thickness. To the northwest of the shaft we pass along for 70 feet and enter a chamber 64 feet long. The vein in this chamber varies from 5 to 15 feet wide. At the northwest end of the chamber is a drift 19 feet long.

We ascend now to the adit level of No. 7 shaft. The sole of this adit is

*Scrammers, a small party of skilled miners who take contracts for mining out ore in places where it is usually too expensive to work on company account.

75 feet above the bay. The ore from No. 7 pit was formerly raised to the adit level by a single cage lift, which has now been changed to a skip road; but owing to the nearly vertical dip of the vein, the skip is constructed like a long iron box on wheels, the lower end or bottom of which is beveled from the back side to the front side, so that when the skip is raised just above the nicely fitted opening at the adit level and the trap-door on the front side and near the bottom of the skip is unfastened, the ore slides out into the tram car. It is certainly a very practical method of emptying the skip where there is not sufficient room to dump it.

Out of No. 7 adit we go 410 feet southeasterly to the double cage lift of Nos. 6 and 5 shaft. The collar of this shaft is 107 feet above the bay. We take our places on the elevator, and very quickly are lowered 297 feet down to the sixth level, or 190 feet below the bay. On either side of the shaft from the third level down have been left continuous pillars of ore, 40 feet thick, extending from foot to hanging wall, and are cut through at the sole of each level to form a passage way to the workings beyond. The vein of ore on the sixth level in the shaft will probably average 90 feet thick, and the shaft sunk in this solid block is perfectly safe, even should a large fall of rock ever occur in the openings to either side. The shaft is sunk to the seventh level. This is accomplished, as was described in our report for 1878, by sinking a winze on the hanging wall side of the shaft. When the shaft is sunk the timber work for the cages is made ready, so that all that remains is to knock out the false bottom and make the connections, which is usually accomplished in a few hours. From the shaft we will first proceed northwest through the arch made in the pillar, and enter a chamber which is 30 feet with the vein and 60 feet wide across the vein. In the south corner of this chamber is a winze which will be connected by a drift with the shaft at the seventh level. From this chamber we continue northwest through another arch on the hanging wall side and enter the second chamber. In this chamber they are now stoping out the ore across the vein from hanging to foot.

The general plan of working the vein of ore as long as it maintains its present width will be to leave the 40-foot pillars of ore as above described, and then to leave at every 30 feet alternating chambers and pillars of ore. To do this will require the sinking of a winze in the south corner of each chamber from the level above and driving a drift to connect with the winze. Besides this there will be left at every three or more levels a roof of ore, and where necessary large stulls will be set across the chamber and lagging be laid on them to prevent any loose rock from falling upon the miners below.

In the southeast of the shaft, on the sixth level, the foot wall preserves its course past Nos. 5, 4 and 3 pits, a distance of 340 feet, but the hanging wall turns from the shaft sharply to south, so that in the first chamber it is 160 feet from foot to hanging walls. This is all ore, with exception of a ten foot seam of chloritic schist, which occurs about two-thirds of the way across from foot to hanging and separates the specular slate ore on foot wall side from the magnetic ore on the hanging wall side of the vein. The first chamber on this side of the shaft is nearly worked out, and they are opening a second chamber. The method of working this side of the shaft is similar to that already described for the northwest side, the only difference being in springing longitudinally across the middle of each of the chambers to prevent any lateral movement of the pillars.

We return to the shaft and ascend on the cage to the fifth level, which is 58

feet above the sixth level. To the northwest of the shaft on this level the workings are very similar to those in the level below, only that the ore is stoped out of the second chamber and they are driving a shaft next to the hanging wall, between the quartzite and a jasper horse, which latter just comes through into the northwest end of this chamber. In the southeast of the shaft the first chamber is worked out, but in the second one only partially so, and the third chamber is only just begun. They are also mining out a ten-foot vein of ore which occurs inside of jasper on the foot wall side.

The magnetic ore on the hanging wall side is all mined out, with the exception of the heavy arching pillars to the foot of No. 3 skip road, which is about 190 feet from the shaft. This skip road, continued down on its present angle, will probably pass in front of the shaft between the ninth and tenth levels.

Ascending now to the fourth level, 50 feet above the fifth level, or 81 feet below the bay, we find the first three chambers mined out on the southeast, and the fourth one partially so. The magnetic ore and a portion of the specular ore is mined out to the south end of No. 3, or what we described two years ago as the fault, which forms the division between Nos. 2 and 3 pits. The plane of this fault inclines at a high angle to the north. The ore from this level passes up No. 3 skip road to the surface. Between fourth and third levels is a strong, solid roof of ore. To the northwest side of the shaft on the fourth level are two tanks 32 feet long by 6 feet wide. The water from the lower levels is pumped into these tanks by small steam pumps, and is then raised to the surface by a 12 inch plunger pump, which is known among the miners as a "Cornish lift."

In passing through the mine we cannot fail being impressed with the enormous quantity of ore left for supports, aggregating fully one-half of the entire deposit. The apparent loss is not alone in the ore left standing, but also in the extra cost of sinking, drifting, and opening out anew, in order to get around the pillars and arches. At first glance it does seem as if some method might be devised wherein the greater portion of the vein could be taken out, and I have no doubt that, with our modern appliances, some way would be found to do it were it not that it is now purposed at some future day to leave a strong floor of ore between two levels, so that mining operations may be continued below, then to begin and take out the pillars, excepting those on either side of the shaft, to the first level about the floor. When this is accomplished to mill in rock and dirt, filling up the space; then to begin and take out the supports to the next level above, filling in again the space with rock and gravel, and so repeating the operation until the upper levels are reached. This, I believe, could be safely and economically done in some way so that the cost of mining the ore would be no greater than that first taken out.

From the main shaft, or No. 5, we go south about 550 feet to No. 2 shaft, the collar of which is 91 feet above the bay. The formation here has a strike of southwesterly, and dips northwesterly 55°. Taking a seat in the skip we are soon landed upon the fifth level, 230 feet below the surface, or 139 lower than the bay. To the northeast side of the shaft they are driving a drift and sinking a winze from the fourth level, leaving a pillar at the shaft 20 feet thick. To the southwest side the winze and drift are already connected, and they are now stoping out the ore. On the fourth level to the northeast side it is stoped out to 125 feet away from the shaft and there remains now only 20 feet more before the fault is reached, giving a total distance of 145 feet northeast from No. 2 shaft. One hundred and forty feet above the fourth level it

was 120 feet from the shaft to the fault, which shows clearly the northerly pitch of the plane of the fault. The vein on this side of the shaft varies in width from 7 to 12 feet. To the southwest side of No. 2 shaft we pass over on the fourth level and then down onto the fifth level of No. 1 pit, which is not as low by 15 feet as the fifth level of No. 2 pit. On this level they are sinking to either side of the shaft pillars, and are also sinking the shaft to the sixth level. Northeast of No. 1 shaft it is stoped out on the fifth level beyond the pillar to 72 feet from the shaft, where there is a stope 40 feet high by 18 feet thick. The vein of ore has gradually widened from the surface down. The walls, however, are composed in part of a chloritic schist, which requires considerable timbering to secure them. Southwest of No. 1 shaft it is only a short distance to the sharp southeast turn toward the Gibson pit. On the whole, Nos. 1 and 2 pits have greatly improved within the past two years.

One hundred feet southwest of No. 1 shaft is the Gibson pit. The ore vein from No. 1 pit takes an abrupt turn to the southwesterly, and at the Gibson makes a sharp, spur-like fold on itself into the foot wall, the banded jasper conforming to it. The ore is mined out to 210 feet below the collar or 120 feet below the bay. The body or lens of ore pitches to the northeasterly at an angle of about 45°. Back of this lens, along the spur, the vein narrows, in fact nearly pinches out, but at 75 feet it again widens out, forming another lens of ore which is worked out for 30 feet long to 100 feet deep. This south lens has about the same pitch as the north one. The ore is a fine quality of specular slate. The plan of working the Gibson pit is to sink the shaft, say 50 feet, and then to stope out all of the available ore to that level.

Southwesterly from the Gibson pit about 400 feet, is the Ely pit. The formation at the Ely dips 55° to the northwest. The collar of the shaft is 87 feet above the bay. We now enter the skip and quickly reach bottom, or, the sixth level, 212 feet below the surface. From the third level to near the bottom jasper came in on the northeast side of the shaft, crowding it all the way down, but now on the sixth level the ore appears to be cutting under the jasper. To the southwest side of the shaft in the sixth level it is 30 feet to the foot of a stope of specular which averages 25 feet wide and extends back 84 feet on the fifth level. Northeast on the fifth level the jasper is cut through and the ore is stoped out for 75 feet from the shaft. This opening is well secured by heavy timbers and a solid roof of ore above.

From the Ely we pass westerly a few steps to the open Pascoe pit.

This pit has an irregular crescent shape with its convex side to southeast, but its general trend is northeast and southwest. It is about 175 feet long by 75 feet wide. The east half of the pit is 60 feet deep, and the west half 24 feet below the surface. At the southwest end of the pit are two spurs of ore making into the foot wall, and near the northwest corner they are now sinking an 8x14 shaft, which will afford room for two skip roads and a ladder way. The shaft is all in ore and is sunk on an angle of about 55° to 29 feet lower than the bay, or 104 feet below the original surface; 132 feet westerly from from the shaft of the Pascoe pit is the shaft of the Morgan pit.

The collar of the Morgan shaft is 76 feet above the bay. Again entering the skip we are lowered to the fourth level 149 feet below the surface or 73 feet lower than the bay. Either side of the shaft are 26 foot pillars of ore which will be continued down with the shaft. To the east side of the shaft we pass through the arch of the shaft pillar and enter a chamber 30 feet wide and 48 feet across the hanging wall deposit of ore. A drift was driven into the ap-

parent foot wall of jasper, but within a few feet it struck ore again. To the east of this chamber is a 30 foot pillar of ore extending across the vein, and then comes a second chamber which is now being worked out. The plan of working this pit is similar to that of No. 6 already described. West of the shaft beyond the pillar on the fourth level has been stoped out a chamber 40 feet wide. On the third level to the east the two chambers are nearly mined out and they are now driving a drift to connect with the Pascoe shaft which they expect to within 25 feet east of the second chamber. This block of ground will be left to form a pillar on west side of Pascoe shaft. The hanging wall vein in the first chamber from the shaft is 43 feet wide, the jasper 12 feet and foot wall vein 40 feet, while in the second chamber the jasper disappears and we have 65 feet of first-class specular. The jasper in the first chamber is probably a horse of rock which may cut out below. The chambers of the third and fourth levels are connected by winzes. Looking down these winzes the vein of ore appears to be flattening out in its dip. To the west side on the shaft the ore is stoped out for 75 feet.

Westerly about 200 feet from the Morgan shaft is the Perkins pit. This pit is about 75 feet long by 95 feet deep. The ore in this pit is divided into two veins by a longitudinal run of chloritic schist. The veins are irregular, varying in thickness from four to ten feet. At the time of our visit to this pit last winter, they were then preparing to test the ground with the diamond drill.

The Kingston pit is another of the Republic Company's openings. It is located on the west side of the river, about 1,900 feet northwest of No. 10 pit, and is within 200 feet of the No. 1 pit of the Columbia mine (formerly known as Kloman). The pit is about 110 feet deep by 100 feet long, the vein varying in width from four to eleven feet in thickness. The ore resembles the Republic, but is not quite as rich, and in other respects not quite as good.

WEST REPUBLIC MINE (APRIL 12, 1881).

This company was organized October, 18, 1880. J. N. St. Clair, President; E. G. St. Clair, Secretary and Treasurer; and Geo. A. St. Clair, Superintendent. Their property embraces lots 4 and 6, Sec. 7, and lots 2, and 8, Sec. 18, T. 46 and R. 29. These lands were entered by William Backus in 1851. In 1872 O. S. Bond, of Toledo, O., purchased Mr. Backus' interest and organized the Toledo Iron, Lumber and Water Power Company, which company did some exploring in 1873 and 1874, but failed to find anything of value. Last year that company leased its property to the St. Clair brothers for a term of 30 years at a low royalty, also conceding an undivided one-half interest in the property. The St. Clair brothers then organized the West Republic mine.

The St. Clairs have done more or less exploring on lots 4 and 6, Sec. 7, for the past three or four years, but as soon as they obtained the above lease they began to explore on a more extensive scale, and, after considerable hard, persistent work, finally succeeded in unearthing a solid ledge of specular ore similar in every respect to the Republic.

The "new find" is located in the southwest part of lot 4, and is about 1,600 feet west northwest from the Perkins pit of the Republic mine. Their No. 1 shaft is about 250 feet east of the Michigamme river, and, say 50 feet north of the south line of lot 4. The shaft, 8x12, is sunk 27 feet through earth and then 49 feet into the ledge, composed of specular ore, some jasper and a little chloritic schist.

From near the bottom of the shaft a 6x6 drift has been driven northwesterly, which is all in ore with the exception of a narrow run of chloritic schist. A winze has been sunk in this drift, which will connect with the shaft at a lower level. The strike of the formation is N. 80° W. and the dip high to northerly.

About 100 feet northwest of the shaft is a test pit sunk to the ledge of quartzite, and from the bottom of the pit a drift has been driven southerly 42 feet across the quartzite, where a ledge of specular ore was struck; the drift was continued for 31 feet farther across the vein of ore and then came upon jasper.

One hundred and sixty-four feet westerly from No. 1 shaft, along the course of the vein No. 2 shaft has been sunk 23 feet through earth to the ledge of specular ore. A short cross-cut to the south shows 20 feet of ore at this point. The collar of this shaft is 15 feet above the water in the river, and the collar of No. 1 shaft is 25 feet above the same level. This makes the surface of the ledge in both shafts below the water level in the river, or bay; still there is not much water, at present, coming into either shaft, which is a little surprising, considering that No. 2 is not more than 75 feet from the water's edge at the river.

It is the intention of the company to thoroughly explore the property the coming season. Across the river to the west they are now sinking test pits on lot 6, but have not, as yet, discovered anything new.

KLOMAN MINE.

This mine is located about 300 feet northwest of the Kingston pit of the Republic. Its workings are on the southwest slope of a side hill, and are 1,320 feet in length. The general trend of them is N. 40° W. The mine was first opened in 1872 by the Kloman Iron Company and was worked by that company with considerable vigor until 1874, when operations were suddenly stopped. The mine was allowed to fill with water and nothing more was done there until last winter, when Messrs. Campbell, Wilkinson, and Spear of Marquett obtained a lease and began pumping out No. 1 pit. Shortly after this, however, they sold their lease to Messrs. Shumway, Wicker & Co., who continued the work of unwatering the mine and began mining ore. Subsequently the Columbia Iron Company was organized.

The workings of the old company consisted of four open pits and two shafts, which were numbered from southeast to northwest, the shafts being at the northwest end. The southeast end of No. 1 pit is at the south line of section 6, town 46, range 29, and is 1,300 feet east of the southwest corner of that section. On the surface the pit is about 200 feet long and 20 feet wide. Last summer it was 100 feet long in the bottom by 79 feet deep, and there were about 9 feet of first and second class ore. Since that time they have sunk some 30 feet deeper and report an increase of the width and an improvement in the quality of ore. No. 2 pit is 47 feet northwest from No. 1. It is a small opening only 55 feet long with a short run of ore in the bottom. No. 3 opening, 140 feet northwest from No. 2, is 218 feet long and 110 feet below the surface. Vein of ore is said to vary from 5 to 13 feet in thickness. Nos. 3 and 4 pits are only 20 feet apart, and are separated by a pillar of mixed and good ore. No. 4 pit is 113 feet long by 200 feet deep. In the bottom is only 5 feet of ore. From No. 4 to No. 5 shaft is 462 feet. The shaft is 133 feet deep. On the southeast side of it little or no work has been done, but on the west side it is stoped away from 20 to 30 feet. The vein varies from 2 to 7 feet in thickness. No. 6 shaft is 142 feet northwest from No. 5. The

lens of ore in this shaft pitches to the northwest on an angle of 40°. The workings extend northwest of the shaft for 150 feet and under the bay. The lowest level is about 100 feet below the surface of the bay. In the southeast end of the bottom level is reported 10 feet of ore.

Explorations to the northwest of No. 6 shaft have demonstrated that the same vein of ore upon which they are now mining extends in that direction for nearly three-fourths of a mile, but as yet they have not found the vein of sufficient thickness to warrant opening it for mining operations.

In their main openings, which we have just described, the present lenses are apparently becoming exhausted, but they will undoubtedly find others near at hand, and with this in view they are now boring some diamond drill holes in the vicinity of the old pits. The ore is a fine-looking specular slate variety, resembling that of its near neighbor, the Republic, though not of quite as good a quality. Possibly other lenses of it which they have not reached may be fully as good as the Republic.

The officers of the Columbia Iron Company are as follows: President, P. B. Shumway; Secretary and Treasurer, B. H. Jones; General Manager, C. M. Wicker; Sales Agents, A. B. Meeker & Co.

HUMBOLDT IRON COMPANY.

The chief attraction at this mine now is their so-called "new find," which was discovered last summer. It is located 1,300 feet southeasterly from the workings of the old Washington, and from 300 to 400 feet easterly from the Republic branch railroad; or is near the southeast corner of the N. W. ¼ of the N. W. ¼ of Sec. 11, T. 47, R. 29.

The main opening is now, March 18, about 30 feet deep and 100 feet long. The strike of the formation is S. 10° E., and the dip is 49° to the west. The greater portion of the ore is a rich specular, schistose in structure, often friable, and sounds leaden when struck with the hammer; another portion is a granular specular, more or less magnetic and resembles a magnetic ore, but it affords a brownish red powder (martite). The hanging wall is a conglomerate and the foot wall a banded jasper. In the bottom of the pit it is about 25 feet horizontally from foot to hanging walls. On the north end of the opening considerable stoping has been done. One hundred feet to the south a shaft has been sunk some 80 feet on the foot wall side of the vein. It is all ore in the bottom of the shaft and as the shaft does not extend to the hanging wall it is impossible to say how wide the ore vein is at this point. The ore from the shaft is nearly all of the first described variety of the main opening; it is, however, often wavy.

Ninety feet further to the south is another shaft 30 feet deep. This shaft is connected with the first one by a drift which follows the ore. To the southwest is a large swamp, but the top of the ledge is above the swamp level so that but little, if any, water comes into the workings from that source. The company are busily employed building an engine house, erecting derricks, and other preparatory work in anticipation of a good business this season. About 600 feet west of main shaft they are now sinking some test pits, and have found some very fine looking granular specular ore.

From the magnetic attraction it appears that the ore vein extends to the northwest and also continues to the southeast, and probably unites with the "new find" forming one and the same stratum. The dip, therefore, of this northwest belt will, no doubt, be to the northeast, which would give us a syn-

clinal, converging to the south, between the new opening and the above test pits. A diamond drill hole put down midway between these points would soon prove or disprove this theory. If it were found correct the fact would be of much value in determining the future plan of working the mine.

The only other work now being done by the Humboldt Iron Company, is in the main opening of the old Washington, which is down 300 feet on the dip of the vein (60° to the northwest).

The strike is nearly east and west. The vein in the bottom varies from 10 to 12 feet thick, but the ore is somewhat mixed in places. The bottom is now about 100 feet long. The ore to the east end on the bottom suddenly narrowed. To the west it appears to have "jumped into the hanging wall," as the miners term it.

Immediately south of Clarksburgh more or less exploring has been done for the past ten years. Several deposits, or lenses, of specular slate ore have been found, but were soon worked out. Some eight years ago Captain James Tobin relates that, during the prosperous days of the Michigan Iron Company, he had a small force of Cornishmen test-pitting south of Clarksburgh. A large number of test pits were sunk, when one day the men came in with the cheering news that they had found a fine body of specular slate ore, which covered the entire bottom of the test pit. The men were quite jubilant and demanded a keg of beer, which was willingly furnished. The beer drank, the men again resumed their work, but all to soon exhausted the promised mine.

In one opening located on the S. ½ of the S. W. ¼ of the S. W. ¼ of Sec. 7, T. 47, R. 28, the Michigan Iron Company mined out about 2,000 tons of ore, which they used chiefly in their own furnaces. The opening is 100 feet long by 22 feet deep, and has a trend S. 30° E., which corresponds to the strike of the formation. Near the center of this opening the

CONRAD IRON COMPANY,

which was organized in 1880, sunk a shaft last year to 38 feet below the bottom of the old opening, or 60 feet below the original surface. The shaft inclines to the northeasterly on an angle of 70° from the horizontal. After sinking some 18 feet of the shaft they drifted about 14 feet to the southeasterly and then carried this entire length down with the shaft, forming a chamber, including the shaft, of 20 feet long and, say, 30 feet high. On the northwest side of the shaft it was all rock (quartzite and soapstone), but to the southeast side, at the far end of the chamber, it was 12 feet wide, all ore, it was claimed, except one two-foot run of rock. The larger portion of the ore is a granular-specular variety, containing considerable magnetite, also finely disseminated chlorite. The other variety is porous, rather soft, brownish-red hematite ore. They have taken out of the shaft about 200 tons of the above ore.

Early last fall the Davids brothers traced the vein and sunk a test pit about 500 feet southeasterly from the above-described opening, and discovered a ledge of fine-looking specular slate ore. They supposed they were on the N. E. ¼ of the N. W. ¼ of Sec. 18, but when a survey was made it was found that the test pit was located 25 feet across the line on the N. W. ¼ of the N. W. ¼ of Sec. 18, the property of the Conrad Iron Company.

The strike of the formation here is S. 75° E. and the average dip is 55° to the south. The foot wall is a quartzose rock, impregnated somewhat with chlorite.

At the date of my last visit, February 21, there was a trifle over four feet of

ore in sight in the shaft, measured at right angles to the dip, but a drill hole had been put into the hanging wall side some 10 or 11 feet on a downward angle of about 10°, and it was claimed that it was all in ore. A cross-cut drift which they propose driving into this new discovery will soon determine this question. The ore in the bottom of the shaft was in three or four strata, which were separated by soapstone varying in thickness from one inch to one foot. The aggregate thickness of the runs of ore have gradually increased from the surface down, and from present appearances promises fairly good, but it would not surprise me if the lenses proved small.

The Davids brothers, after finding that the discovery they had made was not on their own property, proceeded at once 50 feet further east, and there sunk another test pit, this time on their own leasehold. Their shaft was down, February 21, about 45 feet. Some days they have from two to three feet of specular slate ore and again within a few feet it pinches out entirely. The present season will be an interesting one in the history of this range.

NORTH RANGE.

This north or middle iron range is considered the eastern extention of the Michigamme east of Michigamme lake, and the eastern extension of that portion of the Ishpeming range west of the Excelsior mine. For several years past the existence of this middle range has been generally believed in, but exactly where it passed was not so well known as now.

During the summer of 1879 Messrs. O. J. & M. E. Davids discovered hard specular ore of a superior quality on the present site of the Boston and Sterling mines. The openings of these mines are located about one and one-half miles northeasterly from Clarksburgh on the south half of the southwest quarter of section 32, T. 48, R. 28. In the winter of 1879–80 Messrs. J. C. Morse, James Pickands, and others obtained a lease of the M. H., & O. railroad company of the east half of the southwest quarter and the west half of the southeast quarter of section 32, and began soon after systematic explorations on the same. After digging a number of test pits and sinking a couple of shafts several feet down into the ledge, they felt warranted in availing themselves of a proviso in their lease which entitled them to a purchase of the property by an appraisal. This done the "Boston Mine" as a company was organized.

Explorations were now continued on a more extensive scale. Wagon roads were built, an ore dock 100 feet wide by 300 feet long was constructed, side tracks were graded, 5,000 cubic yards or more of earth were removed to uncover about 250 feet of the ore vein, buildings were erected to accommodate the miners, and such other work performed as is necessary on an entirely new mining location.

The strike or general trend of the ore vein and the associated rock is N. 75° west, and the dip is 80° to the south. The vein or stratum of ore at the surface of the ledge varied in thickness from one to six feet, but in the present workings it is from six to fifteen feet. The greater portion of the ore is a fine, steely-grained bluish-colored, hard specular, which averages high in metallic iron, is low in silica and contains the smallest percentage of phosphorus of any ore yet discovered in the Marquette iron district.

The following are all the analyses of the ore that the company have in their possession:

	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.
Metallic iron	67.12	67.70	67.75	67.357	69.02
Phosphorus	.027	.017	.015	.016	.018
Silica	1.40	1.35	1.19	-----	1.15
Insoluble residue	-----	-----	-----	3.785	----

No. 1, samples taken by myself across the vein at the surface as an average; No. 2, some 50 pieces taken from the stock-pile by Messrs. Tuttle & Co. as an average; No. 3, some 250 pieces collected by D. H. Bacon, superintendent of Cleveland mine as an average of stock-pile and mine; No. 4, by Lucy Furnace Company; No. 5, by Wheeler Iron Company. First three analyses were made by myself.

The above analyses show how well the ore is adapted to the manufacture of Bessemer steel pig iron.

The hanging wall of the vein is a gray quartzite, very similar to that of the Champion and Michigamme mines, and the foot walls is a banded jasper. Prof. R. Pumpelly, in charge of the mining department of the United States geological survey west of the Mississippi river, this winter examined carefully the Boston and Sterling mines and their associate rocks, and pronounced them identical with those of the leading hard ore mines of this district, which view entirely corresponded with my own.

Actual mining was begun at the Boston mine with a small force of men about the middle of May of last year.

The Marquette, Houghton & Ontonagon Railroad Company, as soon as they were satisfied that the Boston and Sterling mines were of a permanent character, began the construction of a branch, two miles in length, to these mines, and on August 23 the first train reached the ore dock at the Boston mine. At this date the Boston mine had about 3,000 tons of first-class ore in stock pile. Before the close of navigation the shipments aggregated 6,478 gross tons. Since that time they have put in a large tubular boiler and hoisting engine, with four four-foot drums. Two of the drums are Merritt's improved internal friction, which for simplicity of construction, adaptability to the work required, and ease with which they are operated under all conditions, are certainly ahead of anything of the kind which has yet come under my observation.

The ore vein on the Boston mine property has been explored and found good for 600 feet or more, and has been traced to the east with the dip needle and solar compass for as much farther. The mine at present (March 1) employs 50 miners, and is taking out daily over 100 tons of first-class ore. The main shaft is over 80 feet deep, which affords two 25-foot stopes to the east and a 30-foot stope to the west. The product for this season will probably reach 15,000 tons. The officers of the company are J. C. Morse, President; Alex. Grant, Superintendent.

THE STERLING MINE

adjoins the Boston immediately to the west, and embraces in its lease the W. ½ of the S. W. ¼, Sec. 32. The workings of the two mines are separated by a pillar of ore only. The ores, therefore, as well as the associate rocks are the same. Operations were begun there by the lessees, Messrs. A. Kidder, of Marquette, and J. Outhwaite, of Cleveland, in the spring of 1880, but have not been conducted on such an extensive scale as at the Boston mine. Their pres-

ent opening is about 70 feet long by 40 feet deep. Mr. Kidder is now sinking a boiler iron caisson, five feet in diameter, in the swamp 200 feet on the strike of the vein from their main opening. The ledge at this point is 28 feet below the surface, and it is proposed that when the caisson is down to the ledge to keep the water pumped out, and then to sink a large, well-timbered working shaft. The result of this undertaking will be noted by our mining men with considerable interest, as many of them have the same problem to solve. The task, however, is in good hands, and I shall be greatly surprised if Mr. Kidder, with the assistance of Capt. James Pascoe, of the Champion mine, does not bring it to a successful issue. The company intend to put in hoisting machinery this season and to increase their mining force so as to make a fine shipping record for 1881. The shipments for 1880 were 1,198 gross tons.

For the past three year or more considerable exploring has been done between the Boston and Excelsior mines by the Iron Cliffs Company, the Davids Brothers, C. F. Conrad and other, but as yet with no satisfactory results. The Union Iron and Steel Company is now exploring with the diamond drill, the west half of Sec. 3, and the east half of Sec. 4, T. 47, R. 28, or about two miles easterly from the Boston mine. Its intention is to explore the property by completely cross-cutting the formations with a series of diamond drill holes. The formation has an east and west trend and the dip is nearly vertical. The latter feature is rather unfavorable to the above plan operated from the surface.

West of the Sterling mine a couple of miles other parties are exploring on Sec. 36, but the results as regards iron ore are, so far, of a negative character. Six miles to the west and one mile to the north of the Boston and Sterling mines is the Dalliba mine, which is now being opened by the

DALLIBA IRON MINING COMPANY.

The property includes the S. $\frac{1}{2}$ of the N. W. $\frac{1}{4}$, and N. $\frac{1}{2}$ of the S. W. $\frac{1}{4}$ of Sec. 29, R. and T. 48, Michigan.

Extending through the south half of the above last described eighty, in an east and west direction, is a wide shallow valley which descends gradually to the west. Explorations were begun on this property about a year ago; several test pits were sunk which demonstrated the fact that the south side of the shallow valley was underlaid by a deposit of hard hematite and brown iron ore, which averages well in metallic iron, is low in silica, but contains too much phosphorus for Bessemer steel purposes. The formation has a strike of nearly east and west and dips apparently to the north, but at what angle it is impossible to say.

The present workings (March 28), consist of an open pit 160 feet long east and west by 75 feet wide. The opening varies in depth from 7 to 15 feet, which represents the amount of earth covering resting on the ledge of ore. No attempt has been made to break any ore. The ore pockets and engine house are located on the south side of the opening. A branch from the M., H. & O. R. R. will come in from the west and pass along the south side of the pit. The skip roads, now in course of construction, will extend from the pockets down into the pit, and as soon as these are in operation it is purposed to sink a skip road cut into the ore of sufficient depth to afford workable stopes to either side of the skip road. The bottom of the pit is about 60 feet across north and south, and is composed, as far as can be seen, of ore and rock, the former, however, predominating. The stripping will be carried on with the mining of the ore

during the shipping season, so that the mine can ship several thousand tons of ore this season. The officers of the Dalliba Iron Mining Company are President, James H. Dalliba; Secretary, W. S. Pollock; Treasurer, D. Z. Norton; Agent, Ed. A. Skinner.

About two-thirds of a mile west of the Dalliba mine is the first opening of the

NORTHAMPTON MINE.

This opening is near the center of S. E. ¼ of Sec. 30, R. 29, T. 48, Michigan. The mine is being opened by the Champion Iron Company. It was purchased by this company about a year ago from the Morgan Iron Company. The owners are now busy removing the earth, which varies from 3 to 6 feet in depth from the ledge of ore. The ore is very similar to that of the Dalliba mine. Four hundred feet to the west of this work is the main pit of the Northampton. The opening is 120 feet long, east and west, by 60 feet wide. From one small stope about 2,000 tons have been taken out. Near the northeast corner of the pit a shaft has been sunk 30 feet into the ore. The entire bottom of the pit is nearly all ore. The strike of the formation is about east and west, and the dip apparently to the north. A short distance to the southwest is located the engine house, now (March 28), nearly completed. It is purposed to erect ore pockets at the west end of the main opening along side of the M., H. & O. branch, and from there to run the skip down into the pit. The outlook of this mine is very good, and should the demand for this class of ore warrant it, a large amount of ore can be mined and shipped this season.

With the Boston and Sterling mines to the east, the Dalliba and Northampton to the west, it will be surprising if that portion of the north range between these points is not pretty thoroughly explored in the near future.

THE CHAMPION MINE (MAY 1st).

This mine comes to the front as one of the leading mines in the district and proves its name to be no misnomer. Its output in 1880 of 112,408 tons, with the certainty of increasing the yield the present year to at least 150,000 tons, places this mine only fourth in the list in point of production, of the iron mines of the district. The Champion Iron Company was organized under the general mining laws of Michigan in 1869, with a capital stock of $500,000 divided into 20,000 shares. The mine is situated on the south half of section 31, T. 48, R. 29 W., at an elevation above the M. H. & O. R. R. at the Champion depot, which is about a mile distant to the northeast from the mine, of 130 feet. The surface appearance about the mine is unusually pleasant. A number of attractive dwellings are to be seen, with handsome yards and well cultivated gardens. From the elevation at the mine a fine view is presented over the surrounding country. An excellent road connects the mine with the railroad depot, bordered the entire distance with a substantial plank sidewalk.

The discovery of the mine was made in 1867, and a small amount of ore was mined and shipped the following year. The strike of the formation is east and west and the dip is 80° to the north. The ore, which is of the finest quality of magnetic and specular slate, is found in lenses lying between the quartzite on the north and the greenstone on the south, a space of about 140 feet. The north lens, adjacent to the hanging wall, was until a few years ago supposed to constitute the main deposit of the mine, until drifting and the diamond drill revealed the existence of the lenses to the south. The value of the

diamond drill in mining exploration is illustrated by its use in this mine. The shafts, of which there are eight, are sunk in the deposit, near the hanging wall, and the successive levels are at a distance apart of 60 feet. The surface shows less of the great artificial chasms to be seen on many of the large mining locations, the mining work having been early conducted underground. The lenses of ore to the south are reached by cross-cuts, in which are laid the tracks for the tram cars. The mine is now yielding 400 tons per day and the force employed averages about 350 men.

The walls of the belt in which the ore occurs are quite regular, the intervening space being occupied by the lenses of ore, mixed ore and rock, and masses of chloritic schist. As before stated, the mining, until within a few years ago, was carried on in the ore immediately underlying the hanging wall, until the diamond drill penetrating what was supposed to be the foot wall, discovered the lenses to the south. In exploring in this direction the drill is withdrawn as soon as it reaches the greenstone; and in one part or another of the mine it is kept constantly at work. The south lenses have a northeast inclination to the main or north lens, which latter is parallel with the quartzite.

"A" shaft, the most westerly one, is worked out, unless future exploration shall discover some hidden deposits at present unknown. No. 1, 500 feet west from "A" shaft, is opened down to nearly the third level, but is now idle; a diamond drill boring inclining to the north at an angle of 45° from the bottom of this shaft struck a fine lens of ore, and a shaft has just been sunk to it. No. 2 shaft, 300 feet to the west, is down to the sixth level; a diamond drill hole to the east from this level, after passing through 117 feet of barren ground, struck a lens of ore, which is probably the same that was intersected from No. 1. Three lenses of ore are worked to the south of No. 2, which are reached by four cross-cuts. The north deposit has an average width in the fifth level, from No. 2 shaft, of about 25 feet. A southeast deposit, reached by a cross-cut 110 feet east from the shaft, in the third level, has a length of 100 feet and a width of about 30 feet. Another south deposit, nearer the shaft, is reached by cross-cuts in the fourth and fifth levels. The productive portion of the mine, at present, extends east of No. 2 to No. 5 shaft, the greater proportion of the ore being hoisted from No. 3 shaft, near which it is mined, and which is 200 feet west of No. 2. The ore at No. 3 is mainly got in the sixth, seventh and eighth levels, though the shaft is down to the ninth level, 540 feet from the surface, though the skip road only reaches the eighth, the hoisting from the bottom to the eighth level being done with a bucket and derrick. In the sixth level the ground to the west has been stoped out a distance of 238 feet, the vein showing 40 feet wide; to the east there is also no standing ground. The length of the opening in this direction is 160 feet. Of the south deposits there are two lenses reached from No. 3 shaft by cross-cuts in the sixth, seventh and eighth levels; one of these lenses starts from near the surface east from No. 2 shaft and extends downward, inclining to the west, reaching the plane of the shaft at about the eighth level. The other, a much larger deposit, which has contributed greatly to the production of the mine, is first reached by a cross-cut in the fifth level, just east of the shaft. In the sixth, seventh and eighth levels the cross-cuts to this deposit are near the west side of the shaft. Two winzes sunk either way, 30 feet from the shaft, connect the seventh and eighth levels. The former level is opened to the west 200 feet, and the vein in the stope at the end shows a width of 40 feet; to the east in the same level the drifting in the vein has reached a distance of

150 feet. In the eighth level the opening extends about 80 feet west and the vein has an average width of 42 feet. A cross-cut to the south leads into a deposit of equal magnitude. The walls of the chamber, which has been formed by removing the ore, are being taken down on the east, south and west sides, and the ore trammed through the cross-cut to the skip.

The ore, while dipping to the north, pitches to the west, and gives every indication of increasing width and of indefinite extension in this direction. The lens of ore recently struck by the diamond drill from No. 1 and No. 2 pits, undoubtedly conforms in direction to the westerly lenses and underlies them. The discovery of this lens greatly enhances the value of the mine, since giving greater extent of working ground and showing that lenses may be found approaching the surface at the east, and while dipping to the north pitch also to the west, having a good width and being persistent in depth.

From the bottom of the pit east of No. 4, 250 feet below the surface, a downward drill hole showed, after passing through 158 feet of rock, 86 feet of ore. This is about 320 feet west from No. 3 shaft and shows that the shaft is in a deposit that will keep its machinery employed for some time to come. No. 4 shaft is 420 feet west from No. 3. It is sunk partly in an open pit that has been worked out from the surface. The shaft is sunk to the sixth level. In the fifth level the ore has been mined out to a distance west of the shaft of 246 feet to a heading of mixed ore. Above this level the ore has all been taken out. In the sixth level they are mining in a stope 200 feet west from the shaft, the vein being 30 feet wide. No. 5, 350 feet west of No. 4, is mined out to the fourth level. The shaft is part way down to the fifth level and 100 feet west of the shaft a winze has been sunk in the ore the depth of a level. The vein shows a width of about 20 feet. No. 6, 150 feet west of No. 5, is only down to the second level, 120 feet, is really a surface winze. West of it the ore is of mixed character, not suitable to mine. Between No. 2 and No. 7,—which latter is the most westerly pit,—a distance of 680 feet, there is a surface outcrop of ore 30 inches wide, but the ground has not been opened. The bottom of No. 7 is 130 feet below the surface, but the deposit has been worked out, leaving an underground opening 200 feet long, 100 feet high, and 20 feet wide. In the fourth level, reached by Nos. 2, 3, and 4 shafts, there has been mined out a total length of 700 feet and an average width of 26 feet. In the fifth level, reached by Nos. 3 and 4 shafts, the length of the opening is about 400 feet and 36 feet wide. In the seventh level, reached by No. 3 shaft, the width becomes about 40 feet, and in the other about 42 feet.

In the working part of the mine, Nos. 2, 3, 4 and 5 shafts, there is an abundance of ore in sight, and the stopes are admirable arranged for facility of mining and securing a large product. The appearance of the mine certainly indicates rare skill on the part of the Superintendent, Capt. James Pascoe, who, for the past seven years has had charge of the mine. Just now they are complaining of the accumulation of ore at the mine, which the railroad fail to remove. A branch from the main line reaches the mine from the east.

The machinery at the mine impresses one as being amply sufficient for the purpose required.

The hoisting apparatus comprises six drums of 7-foot diameter each. Placed in No. 1 engine house and worked by the same engines which operate these drums, are two Delamater 14x40 inch compressors, and a duplex Rand compressor with 10x20 inch air and steam cylinders. The power drills comprise eight Waring, 15 Rand and two Ingersoll, Capt. Pascoe preferring the latter.

The freedom of the mine from water shows the effectiveness of the pump by the large engine in No. 1 engine house. The necessary machine shop, carpenter shop, etc., the machinery of which are operated by steam power, are also included in the surface plant.

Undoubtedly the prosperous career of this mine and the present favorable condition of the company's affairs, are largely due to the excellent management of the agent, Mr. A. Kidder, who, to business talents of the first order, adds a good degree of skill acquired by many years of experience in mining affairs.

KEYSTONE MINE.

About one-half a mile east of the Champion is the Keystone mine. This mine was first opened by the Keystone Iron Company, during the winter of 1872–73, and in 1873 12,701 gross tons of ore were shipped. For the next three years, owing in part to the panic of 1873, the mine was not worked very strong, but in 1877 it shipped 14,496 tons of ore. The past two years it has been worked by the Saginaw Mining Company under a lease from the Keystone Iron Company.

The outlook of the mine to-day (March 28) is not very bright, but I hardly think it just to attribute this condition altogether to the mine itself. The formation is a little irregular, but it appears to me that with a liberal and systematic use of the diamond drill, a good, paying mine might be developed on this property.

Nos. 1, 2 and 3 shaft are all on the same vein. No. 1 shaft, the most easterly one, is 150 feet deep. For the first 120 feet down it is stoped out to the east only 20 feet, but to the west it is stoped out to 65 feet. The vein varied from 6 to 12 feet thick, and to the east of the shaft it became very narrow and the ore mixed. Below the 120-foot level the vein narrowed and in the shaft was only two feet thick. One hundred and seventy-five feet west of No. 1 is No. 2 shaft. Down to the bottom of this opening, a distance of 130 feet the ore is stoped out 100 feet to the east and 150 feet to the west. The vein of ore varied from 2 to 6 feet wide. Again 230 feet west of No. 2 shaft is No. 3. This is the only shaft worked at present. The first 75 feet of this shaft is sunk vertical, but the remainder of the distance, 150 feet, it pitches to the west on an angle of 45° degrees from the horizontal.

In the bottom of the shaft the vein of ore was 12 feet wide, but it proved to be only a short lens, for within 10 feet to either side it narrowed to less than three feet. To the south of Nos. 1 and 2 shafts, 200 feet, a new discovery was made the past season, which for a time promised large results. Considerable work has been done at this point. The present opening is 75 feet long, southeast and northwest, and is 50 feet wide by 40 feet deep at the lowest point. The ore on the surface of the ledge was from 30 to 40 feet wide, but now in the bottom it is only 6 to 10 feet wide. Whether this new find is a spur from the main vein or is a part of the same separated by a horse of rock is not determined. The question has an important bearing on the future of the mine, for if the latter is the case the two deposits will probably unite as depth is attained, or possibly in the direction of the strike.

The ore of the Keystone is very similar in appearance to the Champion mine but contains considerable more phosphorus and will not average so high in metallic iron.

MICHIGAMME IRON COMPANY.

The Michigamme mine is situated on the north side of the west end of the lake of the same name, on the south half of sections 19 and 20, T. 48, R. 30, the company owning here a body of land comprising 1,400 acres.

The mine openings are in the side of the bluff, which descends from the greenstone ridge on the north to the lake, the formation dipping to the south at an angle of 60°.

The company was organized in the winter of 1870–71, and began work in the following year, commencing the shipment of ore immediately upon the completion of the railroad, and of the ore dock at L'Anse, which latter work was accomplished in 1873, the company shipping that year 29,107 tons. The previous year, however, there were sent away 141 tons.

One of the first operations of the company was the building of a saw mill, supplied also with planer, machinery for the manufacture of sash and doors, etc. This was done partly for the purpose of facilitating the construction of houses, increase the sale of lots, etc., on the plat which the company laid out at the west end of the lake, adjacent to the mine. The village grew with exceeding rapidity, attaining, in a few months' time, a population of nearly 1,400.

Very sanguine expectations were at that time entertained regarding the future yield of the mine, some of the more hopeful believing that it would rival the Republic; but while these too large anticipations have not been realized, the mine has nevertheless annually given a reasonable return, and has ever maintained a favorable outlook.

The veins or lenses of ore, which were first worked in the west part of the mine, have not possessed great degree of width, and have lacked persistence in length and in depth; the quartzite has too frequently come in to cut off or to dislocate the deposits. As a consequence, this portion of the mine is now practically abandoned; all west of No. 4 shaft is idle. The old mine, that has cost a great deal of money to make, is apparently exhausted, and in working to the east the company are in reality opening a new mine, which will afford an extent of vein, between No. 4 and No. 1 (the Barnum) shafts of 800 feet. Two sets of operations are thus necessitated at the present time, the carrying forward of the new openings and getting out the annual product of ore. When the new shafts are completed and furnished with skips, and the vein sufficiently opened for stoping ground, the mine will be in admirable shape. The width of vein that can then be worked will enable the company to double its annual product. The main portion of the product is now obtained from No. 4 pit, in the fifth and sixth levels. In the fifth level the vein is opened to a distance, to the east, of 260 feet from the shafts, the opening showing a width of from 20 to 40 feet. No. 3 shaft is lowering to meet this level, when it will be used for hoisting also. Between No. 4 shaft and the head of the drift to the east is a winze furnished with skip worked by a small hoisting engine and drum, which runs the ore up to the level above, whence it is trammed to the shaft.

To the west of No. 4, 250 feet, the vein is cut square off by a heading of jasper which extends down from the surface. The vein has been recently opened to the sixth level, 380 feet down, and drifted each way in it a distance of 50 feet. The hanging wall is widening out, while the foot wall preserves its uniform angle, thus increasing the width of the vein with the increase in depth. From this shaft they are now hoisting about 150 tons per day.

No. 3 will soon be ready for the skip road down to the fifth level, and No. 2, still further to the east, is down about 200 feet, and at this depth they are now stoping in a very wide portion of the vein, the opening showing a width of 30

to 40 feet and a length of 75 feet each way from the shaft. The stopes at the heads of the drift are equally wide, as is also the bottom. No 1 is sinking at an angle of 60° to the south to the vein, which is 138 feet below the surface and 27 feet in thickness, as shown by the diamond drill. The shaft has just reached the ore and a drift will be cut to the hanging wall, when a level will be sunk in the ore and the shaft carried down to it against the hanging wall.

The ore is the best quality of specular and magnetic. In working eastward the mine is gradually approaching the lake, and it is possible that in the course of time it may extend beneath it. The shafts are all worked and the hoisting will continue to be done from the main engine house, which is a substantial, commodious stone structure, supplied with a hoisting engine 28x36 inches, four winding drums eight feet diameter, six feet face, capable of holding 1,300 feet of one and one-eighth inch wire rope. The machinery was manufactured at the Hodge Works, Detroit. In this building are also placed the compressors—one National duplex, 16x24, steam and air cylinder, and one 14 inch Delamater.

The pumping engine is 14x26 inches, Corliss pattern, working two six inch lifting pumps; 1,800 feet of wire rope are required for the transmission of the power from the engine to No. 1 shaft; two diamond and 13 power drills are employed, and the boilers comprise two large stationary and two portable. The company employs about 200 men, as industrious, quiet, effective force of laborers as can anywhere be found.

The general oversight and direction of affairs is under the supervision of Mr. J. C. Fowle, who has been on the ground, in the company's service, since the first blow was struck, three years as cashier and five years as superintendent. The working of the mine is in the immediate charge of Capt. Christopher, who has held this responsible position for five years past, and has shown himself competent for the duties devolved. In fact, the working of the mine, the plans for its extension and future development, and everything pertaining to the company's affairs, as seen about the location, betoken excellent skill and management, and lead one to entertain a high opinion of the business and mining abilities of the superintendent and mining captain. The present officers are Hon. Wm. H. Barnum, President, Lime Rock, Conn.; James Rood, Secretary and Treasurer, Chicago, Ill.; J. C. Fowle, Superintendent, Michigamme, Mich.

SPURR MOUNTAIN MINE.

This unfortunate company that began working in 1873 with such extraordinary promise, obtaining from the mine the first year 31,933 tons, and the following year 42,068 tons of ore, came to a total collapse in 1878, through what is generally held to have been the mismanagement of those who had its affairs in charge. The mine is situated on the S. W. ¼ of the N. W. ¼ of Sec. 24, T. 48, R. 31, being distant nearly two miles west from the Michigamme mine. The mine was opened a distance east and west on this vein of about 1,000 feet, and with four shafts or pits having a depth of from 50 feet to 200 feet. The machinery, still in place, comprises a hoisting and pumping engine and four winding drums, four feet in diameter. The mine has been recently sold on a mortgage and bought in by the mortgagés, who have reörganized the company and resumed work at the mine. The work is in charge of Mr. A. C. Davis, well known in the copper district as an experienced mine agent. At this date, June 10th, the mine is nearly full of water. The parties owning the mine are residents of Detroit, Mich.

CASCADE RANGE.

PITTSBURG AND LAKE SUPERIOR IRON COMPANY.

This organization, recently formed and now nearly perfected, includes the franchise and holds the realty of the company heretofore known under the name, together with the mines and lands that were owned by the old Cascade Company. In all the new company own in fee simple upwards of 21,000 acres of land. The Palmer, as it has been called is the only one of the company's mines that is now working at what is known as the Cascade. This mine has proved successful and seems likely to become of increased value. Through the sale of its products and by an economical administration of the affairs of the company Mr. Kirkpatrick, the agent, has been enabled to pay every dollar of the $220,000 of indebtedness which was assumed at the time of the resumption of operations, so that now the new company, owning an immense landed estate, a well equipped and productive mine, a large number of houses and other buildings at the location, etc., are free, as Mr. Kirkpatrick states, of any indebtedness whatever. The "Palmer" is the most westerly of the mines that have been opened on the Cascade, and is the only one that has furnished merchantable ore in any considerable quantity. The mine is furnished with three working skip roads descending into open pits and thence extending underground. Three of these incline to the east, following the foot wall at an angle of 55° in a pit that runs north and south, being about 250 feet long. At the south end of this pit the formation bends to the east and the dip is to the north, and in this easterly pit is the fourth skip, descending in like manner beneath the surface after reaching the bottom of the open portion.

The underground workings are now extended 300 feet from the surface, measured on the inclination of the vein. The average width of the workable portion of the vein in the north pit is about 27 feet; in the east pit it is narrower, but is again widening out to the east, and promises to become of equal dimensions to the west portion. The vein possesses a good degree of uniformity in regard to the quality of the ore, and its walls are well defined, hard and firm. The ore is a specular slate and granular specular, of a quality so good that it is rapidly redeeming the bad reputation which the ore of this range have unfortunately possessed in the eastern markets. Mr. Kirkpatrick is now at work with a diamond drill exploring the ground east of the mine for the purpose of proving the vein in that direction. It is more than probable that the deposit of ore will be found in this level ground between the foot wall bluff of jasper rock on the south and the parallel range of quartzite lying two hundred feet to the north. The drill has only recently been procured and the working of it just begun.

The average daily product of the mine is now 150 tons of ore, which is transported to Escanaba over the N. W. R., a branch of which comes into the Cascade, and extends westerly to the Saginaw and to the other mines of that range. An excellent highway connects the mine with Negaunee, which is four miles distant to the north.

The company employ 200 men in the mine and about the location, and have 93 good dwelling houses for their occupation. A good store, meat market, etc., are also conducted by the company, and are kept supplied with everything necessary for the wants of the population, and the materials thus dispensed are furnished to the people at as low a cost to them as they can procure those articles elsewhere. Mr. Kirkpatrick states that his invariable practice is to buy everything procured for cash, and thus endeavor to secure his goods and other materials at the lowest possible price.

As predicted in the Commissioner's report of 1878, the output of the mine nearly reached to 40,000 tons in 1880, and in the present year will doubtless exceed that amount.

The four drums which hoist and lower the skip cars in the shafts, by wire rope transmission, are placed in the same building with the engine which operates them. Two large boilers supply the steam.

The office of the company is at the location, Cascade, Mich. Joseph Kirkpatrick, Esq., Managing Director and General Agent.

THE WHEAT IRON MINING COMPANY.

This company hold on a lease secured from Dr. Wick, of Cleveland, Ohio, the S. E. ¼ of Sec. 29, T. 47, R. 26, adjoining the Lake Superior Iron Company's location on the east. The mine was first worked, to a slight extent, in 1873, producing like the other mines on this range worked at that time a small amount of ore of an inferior quality.

Recently the lease of the property, as above indicated, has been secured and mining work resumed by the new company under the intelligent supervision of Mr. Amos H. Wheat, who has had a previous experience in mining on this range.

The mine work now being prosecuted is on the north half of the quarter section, at about 200 feet south of the branch railroad track which reaches the mine. The formation here, for a short distance, runs north and south, and then to the south makes an elbow and extends east and west, the former, probably, being a spur of the general trend, which is east and west.

A pit has been opened in the foot wall where it dips to the west, and is down in the ore a distance of 40 feet; to the west, about 100 feet, a vertical shaft has been sunk which is 60 feet in depth and has reached the ore. Further to the south, 150 feet distant, a shaft had been previously sunk, also on the foot wall, but dipping to the north. This shaft is down 75 feet, and from it considerable ore has been hoisted; the vein in this shaft is about 14 feet thick.

An engine, two small winding drums and a pump are now on the ground and will soon be in place and put to work to supersede the primitive method by bucket and windlass now being used.

The ore is similar to that of the Palmer mine, and is carefully selected and picked over, so that the shipping product is of an excellent quality; an analysis made by the commissioner, of average specimens selected by Mr. Wheat, gave a little over 65 per cent metallic iron. An analysis of a single specimen, made in Cleveland, gave 64 per cent. Mr. Wheat expects to ship, the present year (1881), 10,000 tons.

Further to the south, on the low ground, the company have also some hematite openings, but these are not now worked. Thirty-five men are employed, and sufficient accommodations provided for housing them. The officers are Daniel McGarry, President, Cleveland, Ohio; Thomas Axworthy, Secretary and Treasurer, Cleveland, Ohio; Amos H. Wheat, General Agent, Cascade, Michigan.

MENOMINEE RANGE.

FLORENCE MINE.

Since our report for 1879, a great change has been made in the appearance of this mine and in the immediate surroundings. At that date there was only one log house on the mine site and another rough board house about one-half mile to the east, on the west shore of Fisher lake. Between these two points is now the village of Florence. Many of the buildings are attractive and some of the streets are well graded. The hotels are excellent, a rare exception in some of our frontier mining towns.

The railroad track, coming in from the southeast, passes along the southwest side of the village and then curves around to left, passing to the north of the main opening of the mine and abreast of the ore pockets and docks. The railroad track at this point is 722 feet above Lake Michigan. On the north side of the track is a large stock pile of second-class ore which will probably be smelted in some future charcoal blast furnace in this vicinity. From the top of the ore pockets, 40 feet above the railroad track, a double tram road, 500 feet in length, leads south into the main opening of the mine. The mine is located on the north slope of an oblong shaped hill or short ridge.

The first that attracts attention in going into the mine through the open tram road cut is the deep sand drift overlying the ledge. This earth covering is fully 35 feet thick on the west side of this open cut. At the point where the cut intersects the vein of ore, and to the west side is a shaft sunk 50 feet below the tram road level. The strike of the formation is N. 55° W. and the dip 70° to the northeast. The shaft is therefore on the hanging wall side of what is known as the north deposit. The main opening is about 250 feet long by 150 feet wide. On the foot wall are series of hematite schists, and lean ore interstratified with some good ore. This is well shown in an open cross-cut trench on the south side which we mentioned in last year's report, and also in a drift driven 50 feet south into the foot wall from the tram road level.

In the main opening we have two veins of ore; the north one already noted is 35 feet wide opposite of the tram road cut, and the south deposit is 58 feet wide. These two veins are separated by a stratum of plumbaginous schist which is from 20 to 30 feet thick. The south side vein of ore is widening to the west, but how the north side will open out is impossible to say. They are now sinking an open cross-cut into it. In the south deposit a 20-foot stope, from the tram road level down, is being carried from northwest to southeast, taking with it the entire width of the vein. The upper edge of this stope is about 125 feet from the southeast end; midway between these two points and on the north side of the south vein a shaft has been sunk to 50 feet below the tram road level. From the bottom of this shaft a drift is driven north to con-

nect with the shaft on the hanging wall side of the north deposit. They are now sinking around the south shaft an open cut which will be gradually enlarged to the southwest. The water of this opening passes down the shaft and along the drift of No. 1 shaft, where it is pumped out. In the north corner of the main pit they are now sinking another small open cross-cut to 30 feet below the tram road level, and when this is done they will have a stope of ore of this height 35 feet wide.

The ore of the south deposit is nearly all of an excellent quality. It is becoming harder as they go down, and I am told averages somewhat lower in phosphorus than it did at the surface. I am also informed by furnace men who have used it that it is well adapted to car wheel or malleable iron purposes; that it smelts readily in the furnace and affords an easy working cinder. The ore of the mine is raised by means of four derricks, operated by four of Frazer & Chalmer's three-foot drums. To the northwest about 125 feet from the main pit, a shaft has been sunk through 50 feet of sand drift to the ore. Immediately south of the main pit the surface of the ledge, as can be seen on the exposed face of the foot-wall, has an elevation of 60 feet above the tram road level, but it pitches down to the north on an angle of about 30°. The surface of the ledge conforms in a measure to the contour of the hill, and at the northwest end of the ridge pitches to the northwest. It is very probable that the vein of plumbaginous schist separating the two deposits will cut out in depth. The mine employs at present about 200 men and should occasion require it could easily work many more without crowding the mine.

The Florence mine is operated by the Menominee Mining Company, who also own a three-fourths interest in the fee simple and have a lease of the other one-fourth for a term of years. This company also own in fee simple or lease the Chapin, Quinnesec, Cyclops, Norway, Vulcan, and Lowell mines. The respective products of these mines for the last year are as follows:

	Gross tons.
Florence	13,936
Chapin	34,556
Quinnesec	52,237
Cyclops	14,368
Norway	198,165
Vulcan mines	72,571
Lowell	14,571
	400,358

These mines are among the largest and best of the Menominee range and their shipments aggregated last year 70 per cent of the entire Menominee district. The mines of this company are for the most part in excellent condition. Everything about them betokens good management and thorough discipline. The remark is often made that the Menominee Mining Company has the "cream of the range." That the company has its share cannot be questioned. Too much credit cannot be accorded to Dr. N. P. Hulst for his good selections of mining properties and Messrs. J. J. Hagerman and A. C. Brown for having secured these properties to the company.

The officers of the company are: J. J. Hagerman, President, Milwaukee, Wis.; J. H. Van Dyke, Vice President, Milwaukee, Wis.; Geo. D. Van Dyke, Secretary and Treasurer, Milwaukee, Wis.; A. C. Brown, General Agent,

Vulcan, Mich.; N. P. Hulst, General Superintendent, Vulcan, Mich.; Jeff. D. Day, Assistant Superintendent, Vulcan, Mich,

COMMONWEALTH IRON COMPANY.

This company own in fee simple Secs. 32, 33, 34, the S. ½ of Sec. 31 and the S. E. ¼ of Sec, 28, T. 40, R. 18, Wisconsin; also the N. ½ of Sec. 4 and N. W. ¼ of Sec. 5, T. 39, R. 18, Wisconsin. Within the past year the Chicago and Northwestern Railway Company have extended their Menominee River branch to the mine workings on Sec. 34, but owing to the elevation of the mine the main track passes about one-half of a mile north of the mine. A switch track, however, leaves the main line a short distance east of the Commonwealth railway station, and then on an ascending grade extends westward of the mine for say one-third of a mile, and then by means of a "Y" branch returns on an easterly course with a still ascending grade past the ore docks and pockets, located about 300 feet north of the main opening of the mine. The surface of the ground at the mine has an elevation of 1,000 feet above Lake Michigan. The top of the ore pockets is 38 feet above the railroad track. Opposite of the ore docks are three railway tracks. The first one nearest the mine is used for loading the cars from the ore docks; the second track for loading cars out of the pockets, and the third, or outer track, for a switch. By this method, the stock-pile men loading from the ore docks are independent of pocket men. This point is frequently overlooked at many of our iron ore mines.

There are now, May 1st, 17,200 tons of ore on the docks awaiting shipment, and to this they are adding a little more than 2,000 tons per week. The ore in stock pile looks well, and is quite free from rock.

Leaving the stock pile for the mine workings, we note on our way several tram road tracks leading to the stock pile, or to the waste dumps of rock and earth stripping. The removal of the earth from the ore ledge is now being vigorously pushed, so as to have as much ore uncovered as possible in advance of the mining, that the one may not interfere with the other. The strike of the formation is about east and west, and the dip varies from 65° to 70° to the south.

The mine at present consists of one large open pit, 238 feet long by 90 feet wide at the center. The trend of this pit is southeasterly and northwesterly, and is therefore diagonally across the formation. It is 40 feet deep on the north side, from the surface of the ledge, but in the bottom as we go south and west there are three stopes of ore which are now being carried from foot to hanging. In the bottom, on the foot wall side, are two shafts, 100 feet apart, sunk 30 and 35 feet. When the present stopes have reached a certain distance away from the foot wall the shafts will be enlarged and opened out to the east and west to form new stopes of ore for the next lower level. The ore is improving in quality as they go down; some of it in the bottom is very hard, has a bluish-black color, a velvety texture, and a conchoidal, splintery fracture.

The product of the mine at present is raised to the surface in large iron buckets by three derricks, operated by steam power, and are then swung around and dumped directly into tram cars. They are now erecting three more derricks. The three veins of ore of 36, 10 and 60 feet wide, noted in last year's report, are now merged into one, that is all of the same quality.

The hanging wall side vein of 14 feet, mentioned in last year's report, has not been reached as yet by the main open pit. About 200 feet west of the

main pit a cross-cut trench has been opened, exposing the ledge north about 400 feet to railroad track and south for 100 feet. One hundred and seventy-five feet south from the track was uncovered 32 feet of fine looking yellow ochre. Two hundred and sixty-two feet farther south was found 42 feet of ore similar to that of the main pit. This new find is located 200 feet west and 100 feet south of the main open pit. It is probably another lens of ore lapping onto the southwest end of the other, not touching it, however, but with a bar of rock intervening. The trend of this lens is probably a little to the north of west. I also believe that there will be found another lens of ore to the east and north of their present opening. If this should prove to be the case we may expect to find a series of lenses in going westward occurring about in this same order. The workings to the west of here, in Sec. 32, are nearly in the same condition as they were a year ago, little or nothing having been done there.

The development of the Commonwealth is still in a crude state, but for the amount of work done it is certainly the largest showing of ore on the Menominee range. After the mine is properly opened it can produce as much ore and as cheaply as any other mine in this district.

The mining plant of machinery consists at present of four of Frazer & Chalmers' wooden friction drums. They propose soon to put in several power drills, which will largely take the place of hand drilling. The officers of the Commonwealth Iron Company are as follows: President, Alex. Nimick, Pittsburg, Pa.; Vice President, W. U. Masters, Cleveland, O.; General Manager, H. A. Tuttle, Cleveland, O.; Secretary and Treasurer, W. H. Harvey, Cleveland, O.; Agent, W. E. Dickinson.

The company is to be congratulated for having secured the able services of Capt. Dickinson. They can be well assured that the mine will have, as far as lies in the power of an agent, full justice done it.

THE CHAPIN MINE.

another of the Menominee Mining Company mines, and like the Florence has changed "greatly" within the past year. A little more than a year ago five exploration shafts were being put down, but to-day it is the largest ore producing mine of the Menominee range within the State of Michigan. The ore, a soft specular blue variety, averages high in metallic iron and is low in phosphorus and silica, qualities which recommend it to the Bessemer steel trade. At the time of our visit (May 3d) there were 40,000 tons of first-class ore in the stock piles awaiting shipment.

The Chapin mine embraces the south half of the southwest quarter and the southwest of the southeast quarter of section 30, town 40, range 30, Mich. The mine is located on the northerly slope of a hill, and is just north of the south line of the southwest quarter. The drift or earth covering is very deep, averaging about 55 feet. The formation has a strike a little north of west. At the east end of the mine the dip of the formation is 75° to the north, but in the west end it is nearly vertical or a very little to the south, which latter I am inclined to believe should be the true course of the formation.

No. 1 shaft is the most easterly and No. 8 shaft the most westerly one. The workings are confined chiefly to Nos. 3, 5, 6, 7, and 8 shafts. No 4 shaft is to the north of a direct line between Nos. 3 and 5 shaft, and is used to lower timber into this part of the mine. The distances between the shafts are respectively as follows: From No. 3 to 5 it is 300 feet; No. 5 to No. 6 325 feet; No.

6 to No. 7 330 feet; No. 7 to No. 8 225 feet. The elevation of the collar or surface at each shaft about the railroad track abreast of the ore pockets, which latter point is 569 feet above Lake Michigan, is respectively as follows: No. 3, 100 feet; No. 5, 87 feet; No. 6, 68 feet; No. 7, 47 feet; No. 8, 35 feet.

In front of Nos. 6 and 7 shafts are two other shafts for lowering timber. The mine workings, owing to the heavy drift, are entirely under ground. We will begin our examination of these workings and go down No. 7 timber shaft to the second level, which is 45 feet below our datum* or 80 feet below the surface at this point. From the bottom of this shaft is a drift driven westward to connect with No. 8 shaft, and for 10 feet beyond it. The formation at No. 8 dips 80° to the south. Seventy feet west of No. 7 shaft is a chamber 20 feet wide, crossing, cutting the vein. It is now 28 feet long north and south, with chloritic slate on the south side and soft specular blue ore on the north. Directly north of No. 7 shaft is cross-cut drift 65 feet long, which is still in ore. The entire distance was in ore except a 3½ foot run of rock which the drift cut through about 30 feet from the shaft. West of the shaft a longitudinal drift is now in 100 feet. Ascending now the first level, 40 feet above the second, we find that no work has been done on this level to the west; we therefore go 50 feet southeasterly to No. 7 hoisting shaft. This shaft is to have a double skip road. Twenty-five feet east of No. 7 hoisting shaft is cross-cut drift driven south into a jasper; a short distance farther east is another cross-cut driven north. Nos. 7 and 6 shafts are connected on the first level by a drift 330 feet long. West of No. 6, towards No. 7, are four cross-cut chambers, which prove the vein of ore to be 55 feet wide. The first one is 30 feet west of No. 6, and is driven from the apparent foot on the south to the north. Each chamber is 20 feet wide, with 18 feet of unbroken ground between them. The ground is "very poor," that is, will not stand in the pillars, nor can it be trusted in the roof without being firmly secured.

The method of mining out the ore and timbering in this mine is known as the Nevada system. It may be briefly described as follows: A drift is first driven from the shaft along what appears to be the foot wall; a pillar or block of ground is then left on either side of the shaft from 20 to 30 feet thick. Chambers 20 feet wide, more or less, by eight feet high, are then started outside of these pillars and are mined out from foot to hanging. As soon as a chamber is opened ahead 12 or more feet, depending on the nature of the ground, a 12 inch flattened stick of timber is laid along the sides of the chamber; a "set" or "bent," consisting of a cross-sill, posts and a cap, is then set up across the chamber. These bents rest on the flattened subsills and are placed as near the breast of ore as practicable. Lagging timbers are then laid from one set to the other as the work progresses. The narrow space between the roof of the chamber and the top of the lagging is filled in as well as well as possible with wedges, etc., to prevent any giving way of the ground above. On the sides between the posts and the pillars it is closely laced up with lagging to protect the surface of the ore from the action of the atmosphere. An exposed surface of this ore very soon disintegrates and falls away. To mine the stope above this chamber the bents are put in in the same manner as below, and are placed directly over the lower bents. In this way the ore between the levels is taken out.

To continue, we go easterly on the first level 325 feet to No. 5 shaft. Immediately west of No. 5 shaft are four chambers now being worked out

*Datum is the level of track abreast of the ore pockets.

upwards. From the first level to surface at No. 5 shaft it is 92 feet. East of this shaft to No. 3 the usual system of supporting the roof by long stulls was attempted, but the result was a bad cave in of a portion of the walls and roof; fortunately, however, it did not extend to surface. The first level is terminated at No. 3 shaft by a heading of rock which comes down with a steep westerly pitch. We will descend now to the second level again. The dip of the formation at No. 3 is 45° to the north. Westward from No. 3 we pass first through a well timbered drift say 1,200 feet, and then past four chambers, which are just begun, to No. 5 shaft. Nos. 5 and 6 shafts are also connected on this level by a drift, but there is only one chamber, just commenced, and that immediately east of No. 6. West of No. 6 the drift extends 200 feet, which leaves between the easterly drift from No. 7, already noted a distance of 30 feet. There is only one chamber west of No. 6 on the second level. The shafts are being sunk to the third level, and it is the intention of the company to keep at least one level, with its drifts and cross-cuts, opened ahead. This will drain the water from the ground they are working upon above and no doubt but that it will then stand far better in the pillars and roof. The thickness of the vein of ore at Nos. 5 and 6 shafts is 55 feet, and at No. 4 shaft it is 30 feet wide, while at No. 7 shaft it is 65 feet wide at present, but no hanging.

The entire length of the workings from No. 8 shaft to No. 3 shaft is about 1,200 feet, and the difference of the elevation of the surface of the ground at these two shafts is 75 feet. In Nos. 3 and 6 are single skip road shafts. In No. 5 is an eight inch Cornish lift pump and a single skip road. No. 7 is to be a double skip road, and No. 7 timber shaft has at present a single drop bottom skip similar to the one already described in the description of the Republic mine.

Abreast and on the north side of No. 5 shaft is the head of a double incline tram road which transports the ore from Nos. 3 and 5 shafts down to the pockets or ore docks. The angle of this gravity road is only six degrees.

About 50 feet south of No. 5 shaft is the hoisting engine house. In the building are four five-foot umbrella friction drums and two Merritt's five-foot internal friction. West of No. 7 shaft is another building containing six of Frazer and Chalmer's 30-inch drums, which are used for sinking the shafts and winzes. Also west and south of No. 8 is a large engine house now in course of erection, which will contain a large plant of Lane's patent drums. The mine has machine, wood and smith shops; in fact all of the buildings required to operate a large mine, with perhaps the exception of some more dwellings to accommodate the miners with families.

The mine at present, May 2d, employs 670 men, and during the shipping season no doubt will increase the force to 800. Capt. Rundle, the mining superintendent, appears to appreciate the difficulties he has to meet in the mining of this soft ore with unstable foot and hanging walls, and no doubt will accomplish what he has undertaken.

The product for 1880 was 34,566 gross tons, and this season will probably reach 200,000 gross tons.

Diagonally across the valley to west and north about one-third of a mile are the now idle workings of the

LUDINGTON MINE.

This mine is operated by the Lumbermen's Mining Company. The ore, a soft blue specular when properly assorted, is of an excellent quality, but the lens-shaped masses of it, in which form it occurs, have thus far proved to be small.

The company are now engaged in putting down a series of diamond drill holes from south to north with a view of completely cross-cutting the formation from the mine workings south across their property. The mine site has a fine elevation above the valley. It is 138 feet higher than the railroad station at Iron City, or 687 feet above Lake Michigan. It is not reasonable to suppose that this mine has been worked out, or that its largest lenses have been found. The product for last year was 8,876 gross tons.

The next mine we visited was the

KEEL RIDGE.

This mine, under the management of the Emmett Mining, the present owners, has improved very much within the past year. We enter the mine now in an adit which is 47 feet above the branch railroad switch to the mine. To the right of where the adit intersects the vein is No. 2 shaft. From this shaft the adit level extends westward along the vein for 200 feet. Descending to the first level, 60 feet below the adit, we find little or no work done east of No. 2 shaft, but to the west is a high broad chamber. On the south side of this chamber is a vein of red ore 20 feet thick, and on the north side comes in a blue ore. Our chamber is very soon divided by the east end of a wedge-shaped horse of rock. They have now mined out the red ore for 35 feet west of the east end of the horse, and the soft specular blue ore for say 50 feet west along the north side of the horse. The vein of blue ore is about 14 feet thick, and the red ore, on the south side of this horse, 20 feet thick; but the south wall has not been touched. This horse of rock will probably cut out on the lower levels, or possibly the red ore may. The adit level, noted above, is driven in on the red ore vein and is therefore on the south side of the horse of rock. At the west end of this level 200 feet from No. 2 shaft a drill hole was driven north into the horse of rock, and within 35 feet it struck the blue ore. The formation in the mine has a strike of N. 75° W., and nearly a vertical dip. Captain M. Harrington, an experienced miner, is the mining superintendent. The future prospects of this mine are much better than they ever were before, and I understand that it is the intention of the company to develop the mine and get new stoping ground ready as rapidly as possible. The blue ore makes a splendid fix and for that purpose commands an extra price.

The location of the mine is very favorable for mining purposes. It is on the south slope of a side hill. The elevation of the adit above the main track gives an easy down grade to the ore pockets and ample height for the pockets. The hoisting plant is a small one, hardly sufficient for this season's work. To the east of the adit they are now putting down a diamond drill hole to prove the vein at a lower depth in that direction.

The officers of the Emmett Mining Company are; Samuel Kimberly, President; Geo. Boyce, Vice President; R. Williamson, Secretary and Treasurer; E. P. Foster, Agent; M. Harrington, Superintendent.

QUINNESEC MINE.

The surface surroundings at this mine remind one of some of the older Lake Superior mines where but few changes are made. The ore now (May 3) is all raised to the surface and then passes down the double inclined tram road to the pockets or docks as desired. Within the past year No. 4 shaft has been sunk to the third level. The shafts are numbered irregularly. No. 3 shaft, the most easterly one, is sunk on the foot-wall side to the sixth level, or 206 feet vertically below the surface level. No. 1 shaft, 150 feet west of No. 3 shaft, is also sunk on the foot-wall side to the sixth level. No. 2 shaft, 120 feet west of No. 1 shaft, is sunk on the hanging wall side to the fifth level. The collars of Nos. 1, 2, and 3 shafts are all on the same level, which is 118 feet above the railway station at Quinnesec, or 449 feet above Lake Michigan. The collar of No. 4 shaft, which is 300 feet west of No. 2 shaft, is 70 feet higher than those of the other shafts.

We will now go down No. 3 shaft and note what changes have been made in the underground workings. The third level is 93 feet, the fourth level 118 feet, the fifth level 156 feet, and the sixth level 206 feet vertically below the surface. The rock which the shaft cut nearly two years ago, between the fourth and fifth levels, has continued down. It pitches to the west on an angle of about 70° and as yet no ore worthy of mention has been found to the east of this heading of rock in the Quinnesec mine. On the sixth level the first ore is struck 30 feet west of the shaft. The drift continues to 70 feet from the shaft. A winze is sunk from the fifth to 6th levels at 30 feet west of the shaft which gives a fine stope of ore to the west of 20 feet thick and 40 feet high.

We go up the shaft now to the fifth level and pass over to No. 1 shaft, and find that the vein holds its width of 20 feet between these shafts. Descending again to the sixth level in No. 1 shaft, we have a drift driven 54 feet east; vein 20 feet wide with a narrow horse of rock near the foot wall side; another drift is driven 50 feet to the west. Vein for 30 feet west is 21 feet wide, but at this west point the hanging wall approaches the foot and narrows the vein to six feet wide. Ascending again to fifth level, we find that considerable ore remains in the roof of this level between Nos. 1 and 2 shafts. A drift extends west of No. 2 shaft 106 feet, and 30 feet from the shaft in the same direction is a winze connecting the fourth and fifth levels which gives a fine stope of ore eight feet wide by 38 feet high. On the fourth level, 100 feet west of No. 3 shaft a cross-cut drift was driven to the north into jasper on the hanging wall side of the vein, but within 20 feet a fine quality of blue specular ore similar to that of the main deposit was struck, and at this point north it is 20 feet thick. A chamber has been opened out in this north deposit and a drift driven east to nearly opposite of No. 2 shaft. The deposit, however, narrows to less than one-half its width in going east. What there is to the west of where the cross-cut crosses the north deposit is not known. Between the third and fourth levels to the west of No. 2 shaft some ore still remains.

On the third level for 200 feet west the ore is stoped away to roof under the tunnel level. Vein at third level averages about eight feet wide. At the west end of this a drift connects on the third level with No. 4 shaft. West of No. 4 shaft no work has been done. The shaft is now being sunk to the fourth level. The vein of ore varies here from 3 to 6 feet wide.

The Quinnesec vein, with its east and west strike, and dip averaging about 70° to the north shows now a decided pitch of the main body of the ore to the

west. On the whole, there is fully as much ore in sight as a year ago, and its future prospects are apparently fully as good. The mining operations are ably conducted by Captain E. Marcom, the superintendent of the mine, and Dr. N. P. Hulst, the agent of the Menominee Mining Company.

Northwest from Quinnesec about four and one-half miles on the north side of Lake Antoine, and in the east half of the N. W. ¼ of section 20, town 40, range 30, Mich., is the

CORNELL MINE.

It is one of the most picturesque and attractive mining locations on the Menominee range. The wagon road from Quinnesec passes along the north shore of the lake. To the west across the lake is the railroad track skirting the shore in easy curves, to connect the mine with the main line. To the southeast is the west slope of Iron mountain, densely covered with forest trees, which, with their deep green foliage, form a strong contrast to the pine barrens on the west shore of the lake. On the north shore among the houses several trees have been left standing to break the cold winter winds and to afford an agreeable shade in summer. On nearly all mining locations the first object appears to be to destroy everything organic, and then after a year or so to begin and plant trees, or to replace in a small way what has been thoughtlessly destroyed.

The railroad track alluded to above comes in from the west side of the lake and continues along the north side on an ascending grade to the east of the location, and then returns by a Y switch in a northwesterly direction on a still ascending grade to the ore pockets and docks located to the south side of the mine workings. The railroad track opposite the pockets is 624 feet higher than Lake Michigan, or say 55 feet above Lake Antoine. Climbing to the surface level of the mine, 88 feet above Lake Antoine, we find the tram road tracks leading to the mine opening. On this upper level and between the ore pockets and mine are located the smith and wood shops and engine house. The hoisting plant consists of two of Merritt's four-foot internal gear drums, which give the best of satisfaction.

We will now pass on to the mine opening. Ore was first discovered here in the fall of 1879 by Captain John R. Wood, the present mining superintendent, and early last season it promised to rival any of the soft specular ore mines of the Menominee range. There was then a forty vein of ore at the surface of the ledge of an undetermined length; but now the outlook is not as flattering. The workings consist of one large open pit 300 feet long by 75 feet wide at the surface of the ledge, and 110 feet deep at its northwestern end. The strike of the formation is N. 55° W., and the dip 70° to the southeast. The surface stripping is about 25 feet deep. From the southeast end of the pit on the surface of the ledge, the bottom pitches down from this point to the northwest on an angle of 25°, and along this bottom to the lower end of the pit the vein of ore is from 2 to 12 feet wide.

In the northwest end face the lens of ore appears to be pitching under the heading of rock that lies above it, and a drift driven a short distance northwesterly and a winze at the end of it sunk 40 feet in the lay of the formation is looking very well. It is hardly reasonable to suppose that this is an isolated lens of ore, or that another will not be found near at hand, and when found the wonder will be why it was not discovered sooner.

NORWAY MINE.

The Norway is another of the Menominee Mining Company's mines. More open pit mining is done here at present than at any of the Menominee range mines. The surface workings and explorations extend from near the branch railway at the ore pockets to the northwesterly for a distance of more than a quarter of a mile. The general trend of the workings is N. 60° W. by the magnetic needle. The natural surface of the ground northwesterly from the ore docks ascends gradually for about 1,200 feet in that direction, and at No. 8 exploring shaft it has an elevation of 108 feet above the railroad track at the ore docks. The shafts and open pits are numbered consecutively from southeasterly to northwesterly. In describing the working we will assume for our datum or bench mark of levels the level of the railroad track abreast of the ore pockets which point is 430 feet above Lake Michigan.

No. 2 shaft, just east of the railroad, and about 100 feet west of the east line of this property, is sunk to the second level, 100 feet below datum. The first portion of the shaft is vertical, but the lower part of it is on an angle of about 60° to the southwest, which angle corresponds to the dip of the formation. On the first level, 60 feet below datum, is a drift to the east of the shaft 30 feet long which opens into a large chamber. In this chamber the ore is practically all mined out for some distance east beyond the limits of the Norway mine and also upwards on the dip of the vein. In the southwest corner of this chamber is a winze sunk to the second level. From this winze it is purposed to stope out the ore between the first and second levels, leaving, however, a strong roof or back of ore to support the hanging, and to prevent any fall of rock in the chamber from passing down to the second level. The vein of soft specular blue ore on this side of the shaft averages about ten feet thick.

On the first level a drift has been driven westerly. At 25 feet is a winze which is sunk to the second level, and ten feet beyond this is a fault in the formation which can be distinctly traced in the level below. The drift continues from the fault in a course of N. 60° W. for 170 feet, while a branch from it, leaving it a short distance from the fault, turns to the northwesterly and gradually curving to the right until it reaches a course of nearly, if not quite, due north. The latter drift is in 230 feet from the fault. The vein of soft specular blue ore to the northwest of the fault is very irregular. On the second level of No. 2 shaft drifts are driven to the southeasterly 60 feet, and to the northwesterly 70 feet. The vein of ore (Stephenson vein) averages about 10 feet thick, and between the first and second levels it is not stoped out. About fifteen feet easterly from No. 2 shaft a cross-cut drift is driven 45 feet southwesterly, where it intersects another vein of soft specular blue ore seven feet in thickness. A short drift has been driven easterly on this vein. The cross-cut continues southwesterly and within a few feet cuts a vein of hard hematite ore, which is no doubt the Perkins vein. A drift on this vein has been driven to southeasterly 100 feet to the boundary line between the Norway and Perkins mines. This drift has been opened out into a chamber and shows a width in the chamber of 30 feet. The cross-cut is continued and within a few feet is met the same fault noted on the first level. This fault appears to have a course nearly north and south, and pitches to the east at a high angle. The veins west of the fault are very irregular. The cross-cut, after passing the fault, terminates in a longitudinal drift which is driven northwesterly through rock to No. 1 shaft. This drift represents the second level of Nos. 1

and 3 shafts, and is 93 feet below datum. The drift continues northwesterly 200 feet to No. 3 shaft. The ore from No. 1 to No. 3 shafts, between the second and first levels, is all mined out and the space stulled, lagged and partially filled with rock, which has been milled in from the surface. The vein of ore mined out varied from 10 to 18 feet in thickness. On the first level a drift is driven southeasterly 150 feet. This is probably the same vein intercepted between the Stephenson and Perkins by the southwest cross-cut from No. 2 shaft. No. 1 shaft is used exclusively for pumping purposes, the product of Nos. 1 and 3 shafts passing up No. 3 shaft.

West of No. 3 shaft, second level, is a drift leading to the northwest. About 180 feet from the shaft is a branch drift to the left 20 feet in length leading into an opening which is 50 feet in diameter. South of this opening, only a short distance, is another small surface opening, in what is supposed to be the Perkins vein. There is, however, no underground connection between these two workings.

About 75 feet north of the branch drift the main one terminates in a chamber which is about 35 feet across, and is probably in the Stephenson vein.

Along the north side of Nos. 4, 5, 6, 7, 8 and 9 pits, a distance of 800 feet, are tram roads leading easterly to the ore pockets and stock piles. The tram cars pass abreast or under, as the case may be, of the small skip pockets from which they are loaded. The tram roads have a light ascending grade east to west. Nos. 4 and 5 pits are open down to 109 feet below the tram road level or 32 feet below our datum. These pits are practically one pit with an arched pillar left across the center. In the east end of this open pit is sunk a shaft 60 feet deep or 93 feet below datum, which nearly corresponds to the second level of Nos. 1 and 3 shafts. From the bottom, drifts are driven eastward and westward. They are now stoping to the eastward, but to the westward the ground is unbroken. The west drift extends over 200 feet under No. 6 pit.

The elevations of the main working levels of Nos. 6, 7 and 8 open pits, are respectively as follows: East side of No. 6 is 22 feet above datum; west side of same 33 feet, which elevation extends westward to midway between Nos. 7 and. 8 pits. No. 8 is 48 feet above datum. From east end of No. 6 to west end of No 8 it is about 550 feet. The foot wall along this distance at some points appears to be coming in rapidly, but the hanging, or better, the south side of the deposit on this main level, has not been reached, and it is questionable if it can be without taking down a large quantity of the overhanging rock. From the east end of No. 6 to the west end of No. 7 the bottom is nearly all ore, with occasional small lenses or bunches of rock. The ore to the west side of No. 7 is more or less mixed, but on the hanging wall side a spur of good ore appears to be making in that direction. This mixed ore extends to within, say, 50 feet of No. 8 skip road. At the west end of No. 8, about 200 feet from the skip road, is the east end of a large horse of rock, which apparently divides the vein one branch making around to the west on the foot wall side, and other portion on the hanging wall side. The skip road of No. 6 has been sunk to 12 feet above datum, affording a stope on the east side of 12 feet, and on the west of 20 feet. Some rock appears mixed with the ore in bottom.

No. 7 skip road is down to three feet below datum; stopes to east and west are 40 feet high; good ore to east and hanging wall sides. No. 8 is down to 18 feet above datum; stopes of ore on all sides except foot wall are 30 feet high. This skip road opening at the top is about 100 feet east and west and 75 feet north and south. West of No. 8 considerable work is now in progress, removing the earth and the nearly horizontal imbedded sandstone from the surface

of the ore. Northwesterly from this stripping, about 30 feet, is a vertical shaft sunk 80 feet. From the bottom of it a drift is driven to the south 30 feet, where it cuts a vein of specular blue ore that dips 75° to the south. The collar of this shaft is 112 feet above datum. Three hundred feet farther to the northwesterly is the Oliver shaft, which is sunk 80 feet, and will strike the blue ore in 10 feet more.

This comprises all of the important workings of the Norway mine. There is not as much of the red ore in sight as there was a year ago, but on the other hand the quantity of the soft specular blue has materially increased. It is hardly possible that any annual product of this mine will ever exceed that of 1880. The future ore of the Norway, I believe, will ultimately consist entirely of the soft specular blue variety. The mine is well equipped with machinery. The large Corliss engine house, located a short distance to the north of No. 7 pit, contains four of Frazer & Chalmer's 5-foot drums and two of Lane's 5-foot drums, which are operated by a 20x40 inch Corliss engine. To the northeast of No. 4 pit, a few steps, is another engine house with six of Frazer & Chalmer's 30-inch drums. Near No. 1 shaft is a small engine house which has one 5-foot Lane drum and an engine that operates it, and a 7-inch Cornish lift pump. Old No. 1 engine house, located just north of No. 8 pit has been deprived of four of its 30 inch Frazer & Chalmer hoisting drums, only two remaining.

The machine shop is well supplied with lathes, planers, drill presses, etc., but is rather crowded for want of room. The wood shop is also well supplied with wood working machinery. Captain John Olliver, well known in the Marquette district as a thorough and experienced miner, is the mining superintendent.

From the Norway mine, in company with Captain Olliver, we went about 1,000 feet southwesterly to the old workings of the

CYCLOPS.

The outlook of the mine is very different from what it was two years ago. The fine lens of soft specular blue ore which they had in No. 1 shaft is practically pinched out in the bottom, and the large amount of timbering which was put in to support the walls and roof of No. 2 shaft failed to do its work. In fact, the northeast end underground workings are gradually falling in. To the northwest of the old mine and up the steep side hill about 200 feet distant, has been recently discovered a six foot vein of hard steely specular ore, and 150 feet farther to the northwest is a shaft down 75 feet in a 40-foot vein of soft specular blue ore of superior quality. Sixty feet from the top of the shaft is a drift driven northwest which passes through 38 feet of this ore. Each of these veins have been traced some distance to the northeast. The dip is 71° to southeast. It was a matter of surprise to me that the Menominee Mining Company was not pushing these explorations with more vigor, for it seemed that this fine "show of ore" was not having justice done it. In our next year's report we hope to have something better to chronicle of a mine which within 30 days of its first discovery was mining and shipping 150 tons of ore daily. We will now return to the Norway mine and pass over to the

STEPHENSON MINE.

This property embraces the N. W. $\frac{1}{4}$ of the S. W. $\frac{1}{4}$ of Sec. 4, T. 40, R. 29. The southwest corner of this forty is about 150 feet northeast from No. 2 shaft

of the Norway mine. The strike of the formation is N. 70° W. and the dip high to the south. The vein of ore at the surface of the ledge crossed the west line of the Stephenson about 130 feet north of the southwest corner, and the south line at 500 feet west of the same point. This with the southerly dip rapidly exhausted the quantity of ore as they went down into the deposit. There is now only a few thousand tons of ore remaining in their present workings which will be mined out early this season. I am still of the opinion that north of these workings, and within the limits of this property, will yet be found a vein of ore with a northerly dip. The Stephenson and Ludington mines are owned by the Lumbermen's Mining Company, the officers of which are: President, Hon. H. Ludington, Milwaukee, Wis.; Vice President, Hon. S. M. Stephenson, Menominee, Mich.; Treasurer, Isaac Stephenson, Marinette, Wis.; Secretary, Joseph Fleshiem, Menominee, Mich.; General Manager, Geo. E. Stockbridge, Quinnesec, Mich.

Immediately south of the Stephenson mine is the

PERKINS MINE.

The lease of this mine is owned by the Saginaw Mining Company. The present outlook of the mine is rather better than it was a year ago. There is probably less of the red flaggy ore, but the richer soft specular ore is more than making good the decrease in the former. The old derricks and buckets, so well adapted for open pit work down to a certain depth, are being replaced by permanent skip roads. In the engine house are now four of Lane's four-foot drums, which give good satisfaction. The pits are numbered from west to east. No. 1 skip road is down to the third level, or 120 feet below the surface. Opening of third level extends 20 feet to either side of skip road; vein averages 30 feet wide.

Between third and second levels, west of the above opening, the ore is unbroken to the west line of Perkins mine, which is 110 feet west of No. 1 skip road. Above the second level, at 70 feet west of the skip road, there is a 20-foot stope of ore, which also extends to the west line of the property. On the east side of the opening of No. 1 is a pillar 20 feet wide on the strike of the vein, which extends to above the first level; this will be stoped out between the second and third levels, which brings us to the east into another opening 125 feet below the surface, by 40 feet long on the strike of the vein and 35 feet across from foot to hanging; on the second level, however, in this same opening, it is 40 feet from foot to hanging, with the soft specular blue ore on the foot wall side. In this opening there is a seven foot horse of jasper near the center of the deposit. On the east side of this opening is another 20-foot pillar, which extends up to the second level, a distance of 40 feet. This opening will soon be connected on the third level with No. 2 hoist.

No. 2 opening is down 135 feet below the surface. The vein of ore averages about 30 feet thick from foot to hanging walls; has some jasper in center of vein. To the east of No. 2 opening is another pillar, and from the east side of it the vein decreases in width, on the third level, from 30 to 16 feet in going to No. 3 skip road. No. 3 is about 300 feet east of No. 1. The east side of No. 3 opening is more or less mixed with jasper. This run of poor ground appears to be pitching down from the east.

No. 4 shaft is 225 feet east of No. 3. On the first level, 81 feet below the surface, there is 35 feet of ore at the shaft, which width holds good for 40 feet east of the shaft, where the west end of a jasper horse is encountered that

divides the vein, and in the aggregate lessens the quantity. The vein on the north side of this horse is a fine quality of soft specular blue ore, and has a width of 12 feet on the north side of the horse as far as they have stoped, but at a point 60 feet east of the end of the horse in a cross-cut driven north from a drift on the south side of the horse, the blue ore vein shows a width of 20 feet.

West of No. 4 shaft the vein gradually narrows, and at 65 feet is met by the same run of mixed ore and jasper as was encountered east of No. 3 shaft. The shaft is being sunk to second level, when there will be some fine stopes of ore to either side.

The mine employs about 125 men, and with Captain Samuel Mitchell, the agent, and Captain John Perkins, the superintendent, both thoroughly competent mining men of long experience, cannot fail of having complete justice done it. From the Perkins mine, about one mile southeast, is the

CURRY MINE.

The north open pit which we described in last year's report is now down to 83 feet below the old cart road cut leading into the main pit. We now go down a shaft inclining to the north at an angle of about 45°. The ore in the bottom is apparently pitching to the west at an angle of 20°. The dip of the formation, however, is to the north. To the west is a fine stope of ore. The vein is about eight feet wide at right angles to the dip. The long open cut to the southeast is now worked as an underground mine. It is 210 feet long by 95 feet deep in the center, 70 feet deep at the east end, and 60 feet at the west end; vein of ore in east end 10 feet wide, and at the center it is 12 feet wide. On the surface but few changes have been made during the past year. The management is the same as then. Adjoining the Curry forty on the east is the No. 3

VULCAN MINE.

In our report for 1879 we noted the large force of men to work in the open pits, but now the miners have all disappeared. The heavy but muffled sounds from the blasts in the underground workings denote only too clearly where they have gone. In company with Capt. Jerome Schwartz, the superintendent, we will first examine old No. 1 Vulcan which is located about 500 feet to the southeast. On the surface everything presents a familiar aspect. We enter the mine through the same adit we did three years ago. In the open pit we note but little change. The derricks and buckets have been replaced by two skip roads. All the mining is now done underground. One of the skip roads goes down obliquely across the dip of the formation to the west and the other on the dip of the formation to the south at an angle of 60°. We will assume for our datum of elevations the adit level, which is 445 feet above Lake Michigan. The first level is 68 feet below datum. The workings extend west from the shaft sunk on the dip of the formation for 360 feet. In the east end is a chamber cross-cutting the vein from foot towards the hanging wall. The chamber is 20 feet wide east and west, and is 80 feet north and south with ore still in the south end. The ore is a very superior quality of the soft specular variety. The walls being rather insecure they have adopted the Nevada method of timbering already described in our description of the Chapin mine.

To the west of this a wide drift has been driven along the foot-wall side and above it considerable stoping has been done. At 210 feet west of the chamber a cross-cut drift shows the vein to have a width of 40 feet. Sixteen feet further along is another chamber which is similar to the first one. The vein here is 45 feet from foot to hanging wall. From this chamber west the vein rapidly narrows and 130 feet in that direction practically pinches out. This, however, is easily explained by the westerly pitch of the lens of ore. The south shaft is being sunk to the second level. The product of the mine at present passes out of the adit, but very soon a shaft about 250 feet west of where the adit enters the main pit will be sunk to the first level, when the ore from that portion of the mine will pass out of this shaft.

We will now return to No. 3, Vulcan, and examine there the underground workings. The shafts, three in number, are numbered from east to west. To go to No. 1 shaft we pass through an adit. This adit is about 75 feet above the adit of the old No. 1 Vulcan. We will assume this upper adit as the datum for our elevations. No. 1 shaft is sunk on the dip of the vein to the third level, 110 feet below datum. The dip of the formation varies from 40° to 50°. The first level is 42 feet below datum and the second level 86 feet. On the third level, to the east and west, drifts have been driven to 80 feet from No. 1 shaft. In the east drift the vein of ore is eight feet wide, while in west end of the west drift the vein is 20 feet wide. Some stoping is being done to either side of the shaft. On the second level a drift has been driven 325 feet east from the shaft. At the shaft the vein was 10 feet wide, which increased to 14 feet in going east a short distance, but very soon it narrowed to four feet, while at the extreme east end the vein of ore is only two feet wide. This drift passes to the north of the west end workings of old No. 1 Vulcan, and is, therefore, in a separate lens of ore. It looks very much as if there might be a regular system to the occurrence or position of these lenses of ore, which will be, no doubt, understood in the future.

From No. 1 shaft it is 180 feet west on the second level to No. 2 shaft. The vein between these shafts averages about 20 feet thick. Above the second level the ore is all mined out, with the exception of a few pillars.

West again, 120 feet, on the second level is No. 3 shaft. The vein of ore gradually narrows in going west, being 12 feet at No. 2 shaft and six feet at No. 3. No. 2 shaft is down to the third level. A small opening has been made to the east from the bottom of No. 2, which shows the vein to be 18 feet wide.

Returning to the second level again we have a drift 270 feet long, driven west on the vein. The good ore soon pinches out and we have chiefly mixed ore and rock. Nearly all of the available ore is stoped out above the second level. The increase in the thickness of the ore vein from the second to the third level is very noticeable.

Four hundred feet west and 100 feet north of No. 3 shaft is No. 4 shaft. This shaft is down 50 feet in a soft specular blue ore. On the side of the shaft is a strong face of sandstone. At the bottom of the shaft a small chamber has been worked out to the south.

This embraces all of the important workings of Nos. 1 and 3 Vulcan mines; we will, therefore return to the village of Vulcan, and proceed to the East Vulcan mines, located about one mile east of Vulcan, on the S. ½ of the S. ½ of Sec. 11, T. 39, R. 29. A branch track from the main line, leading northeasterly from a point a short distance east of Vulcan station to these mines, affords

ample shipping facilities. This track skirts along the base of the south slope of a steep side hill. The first workings we see are those of No. 3 pit, which are to north of the track a short distance up the face of the hill. The east opening of this pit is down 40 feet. Vein of ore varied from 10 to 12 feet wide, but in the bottom the red slates come in with a northerly dip, and practically cut out the ore. Westerly from the east end of this opening about 50 feet, and 23 feet lower down, is a drift running in a two foot vein of ore, for some 50 feet more at which point a heading of rock is met. The drift continues 22 feet through this and comes into a vein of soft specular blue ore, 15 feet in thickness. What is singular about it is that the vein has nearly a north and south strike. There are short drifts cutting this ore in different directions. A little further to the northwest is the so called middle shaft, which is 130 feet west, northwest from No. 3 opening.

On the next and lowest level of the middle shaft, 124 feet from the surface, considerable drifting has been done, which shows to the north a short run of ore with an east and west strike, cut off to the east and west by a crossing of rock having a north and south strike. This crossing is 11 feet thick, and on the west side is a 9-foot vein of soft specular blue ore, having also a north and south strike. Whether these abrupt changes in the strike of the formation have been caused by faults or sharp turns, I did not determine. They are far more vexatious to the miner than interesting. Three hundred and twenty-five feet west of the middle shaft is the west shaft, which is down 35 feet in an 8-foot vein of soft specular blue ore, but now there is rock in the bottom of the shaft.

About one-fourth of a mile east-southeast from the east opening of No. 3 pit are the workings of what was known last year as the Lowell. A little less than two years ago ore was discovered here by Captain Jerome Schwartz, and a lease was taken subsequently of the property by the Menominee Mining Company. When the pit was first opened there was from 15 to 30 feet of soft specular blue ore in sight. The open pit is about 150 feet long by 30 feet wide and, say, 50 feet deep. Near the center of it a shaft is sunk 110 feet below the surface. From the bottom drifts are driven to north and west, each 40 feet in length. The former struck a vein of soft blue ore from three to six feet in thickness. A drift is driven to east on this for 40 feet and to the west 20 feet. The west drift from the shaft was mostly in lean ore. On the level above the bottom one, 85 feet from the surface, is another drift to the north, which at 40 feet, the same distance from the shaft as the lower one, cut the vein of soft blue ore. At this point of intersection, drifts extend to the east and west, the former 15 feet and the latter 50 feet. The vein of ore varied from six to eight feet in thickness.

About 40 feet north of the west end of the open pit is a shaft. At this place there was on the surface of the ledge what appeared to be a small bunch of soft blue ore, but it has subsequently proved to be the top of a rounded lens of ore pitching nearly vertically downwards. On the first level of this shaft, 65 feet below the surface drifts, cutting the lens in different directions proves the lens to be about 30 feet north and south and 33 feet east and west. On the next level 90 feet below the surface, it is 50 feet north and south and 55 feet east and west. On the next and last level 112 feet down, the lens of ore is about 60x60, showing a gradual enlargement from the surface down. There is jasper on the north and chloritic slate on the south side of the lens. About 75 feet southwest of the shaft is another shaft down to the first level. Thir-

teen hundred feet east of the Lowell is a shaft which is sunk altogether 73 feet. The first 25 feet feet was earth. Surface of the ledge pitches at a steep angle to the north. Fifty feet from the collar of the shaft they drifted 15 feet northeast and struck soft specular blue ore, but after driving six feet in this they came into sandstone. They are now sinking to another level when they will cross-cut again to the north. South of the shaft about 350 feet is an open pit 75 feet long by 50 wide east and west and 70 feet deep. On the surface there was a fine show of ore but in the bottom it is badly cut up by horses of rock. From the bottom a drift runs north 55 feet in lean ore and ends in red chloritic slates. Another drift is driven west 30 feet in rock and small lenses of soft specular ore. In east end of opening a shaft is sunk 15 feet in what appears to be a small lens of ore. Captain John Schwartz, a miner of long experience, has charge of the East Vulcan and its explorations.

We did not visit the Emmett or Breen mines as they are idle and partially filled with water. I understand that the lenses upon which they were mining have been nearly exhausted, but it certainly is not reasonable to infer from this that the mine is exhausted or that other lenses do not ex ist within the near vicinity of the old ones. A liberal use of the diamond drill would, no doubt, return a handsome profit.

It would be well for this company to remember how well their pluck was repaid at the Keel Ridge mine, and go ahead on the Emmett and Breen.

On the Felch Mountain Range in Secs. 31 and 32, T. 42, R. 28, the Metropolitan and Northwestern mining companies are each at work mining ore, and expect to ship considerable this fall, should the promised line of railroad reach there in time to do so. Other parties are exploring in this district, and report very favorable prospects. In the Paint River district are the Mastodon and Sheldon and Shafer explorations, where large deposits of hard hematite ore are said to exist. From the Chicagon Lake district are reported several promising discoveries.

On the undeveloped Agogebic Range reliable parties who have done some work are very sanguine. Some of the ores from that range which I have analyzed average well in metallic iron, and its phosphorus is within the Bessemer steel limits. A branch from the Menominee Range railroad will probably reach the Mastodon and Sheldon and Shafer properties this season.

STATISTICAL TABLE Showing the Total Number of Gross Tons of Iron ore Shipped from Lake Superior Iron Mines. By Chas. E. Wright, M. E., Commissioner of Mineral Statistics.

	Marquette District.	Menominee District.	Totals.
Years Unknown	75,083	.....	75,083
1854	3,000	.....	3,000
1855	1,449	.....	1,449
1856	6,790	.....	6,790
1857	25,646	.....	25,646
1858	22,876	.....	22,876
1859	68,832	.....	68,832
1860	114,401	.....	114,401
1861	49,909	.....	49,909
1862	124,669	.....	124,169
1863	203,055	.....	203,055
1864	247,059	.....	247,059
1865	193,758	.....	193,958
1866	296,713	.....	296,713
1867	465,504	.....	465,504
1868	510,522	.....	510,522
1869	639,097	.....	639,097
1870	859,507	.....	859,507
1871	813,984	.....	813,984
1872	948,553	.....	948,553
1873	1,195,234	.....	1,195,234
1874	899,934	.....	899,934
1875	881,166	.....	881,166
1876	993,311	.....	993,311
1877	1,014,724	10,405	1,025,129
1878	1,030,986	96,597	1,127,583
1879	1,149,969	270,776	1,420,745
1880	1,379,725	592,288*	1,971,913
Total gross Tons	14,214,966	969,966	15,184,932

* Includes Commonwealth and Florence Mines.

THE IRON AND STEEL INDUSTRIES OF THE UNITED STATES IN THE CENSUS YEAR 1880.

BY JAMES M. SWANK, SPECIAL CENSUS AGENT TO COLLECT STATISTICS OF IRON AND STEEL.

NUMBER AND CAPACITY OF THE IRON AND STEEL WORKS OF THE UNITED STATES.

The following exhibit shows the number and capacity of the blast furnaces, rolling mills, steel works, forges, and bloomaries in the United States at the close of the census year, May 31, 1880:

Blast furnace establishments	490
Completed blast furnaces	681
Rolling mill establishments	324
Single puddling furnaces, each double furnace counting as two single furnaces	4,319
Rotary puddling furnaces (Sellers)	1
Danks puddling furnaces	19
Hammers in iron rolling mills	239
Heating furnaces	2,105
Trains of rolls in iron rolling mills	1,206
Nail machines	3,775
Steel works	73
Bessemer steel converters	24
Open hearth steel furnaces	37
Pot holes for crucible steel	2,691
Trains of rolls in steel works	136
Hammers in steel works	219
Forges and bloomaries	118
Forge and bloomary fires	495
Siemens' rotator	1
Hammers in forges and bloomaries	141
Daily capacity of blast furnaces, in net tons	19,248
Daily capacity of rolling mills, in net tons	16,430
Daily capacity of Bessemer steel converters, in net tons	4,467
Daily capacity of open-hearth steel furnaces, in net tons	827
Daily capacity of crucible steel works, in net tons	445
Daily capacity of forges and bloomaries, in net tons	520

The whole number of establishments in 1880 was 1,005. In 1870 it was 808. The percentage of increase in the ten years was 24.38. The size and capacity of the establishments were, however, much greater in 1880 than in 1870. As the capacity of blast furnaces only was given in 1870, no complete data are available for a comparison of the capacity of all the works in the two periods. The daily capacity of the blast furnaces in 1870 was 8,357 tons, and in 1880 it was 19,248 tons—an increase of 130.32 per cent. A comparison of the number of the various works in 1870 and 1880 is given below:

	1870.	1880.
Blast furnace establishments	386	490
Blast furnaces	574	681
Rolling mill establishments	310	324
Steel works	30	73
Forges and bloomaries	82	118

CAPITAL INVESTED IN THE IRON AND STEEL WORKS OF THE UNITED STATES.

The whole amount of capital invested in the iron and steel industries of the United States in 1880 was $230,971,884; in 1870 it was $121,772,074; increase, $107,199,810, or 89.68 per cent.

PRODUCTION OF THE IRON AND STEEL WORKS OF THE UNITED STATES.

The total production of the iron and steel works of the United States in the census year 1880 was 7,265,140 tons; in 1870 it was 3,655,215 tons; increase, 3,609,925 tons, or 98.76 per cent. The following table shows the production of each branch of our iron and steel industries in 1870 and 1880, with the percentage of increase or decrease in the latter year:

IRON AND STEEL PRODUCTS.	Census Year 1870. Net Tons.	Census Year 1880. Net Tons.	Percentage of increase in 1880.	Percentage of decrease in 1880.
Pig iron and castings from furnace	2,052,821	3,781,021	84	
All products of iron rolling mills	1,441,829	2,353,248	63	
Bessemer steel finished products	19,403	889,896	4,486	
Open-hearth steel finished products		93,143		
Crucible steel finished products	28,069	70,319	151	
Blister and other steel	2,285	4,956	117	
Products of forges and bloomaries	110,808	72,557		35
Total	3,655,215	7,265,140	99	

Of the pig iron and furnace castings produced in the census year 1880, there were produced with cold-blast charcoal, 79,613 tons; with hot-blast charcoal, 355,405 tons; with anthracite, 1,112,735 tons; with bituminous coal and coke, 1,515,107 tons; and with mixed anthracite and coke, 713,932 tons. The furnace castings amounted to 4,229 tons. The total production was 3,781,021 tons, of which 12,875 tons were spiegeleisen.

In the following table is presented a comparative statement of iron rolling-mill products in the census year 1870 and 1880:

KINDS OF IRON.	1870. Net Tons.	1880. Net Tons.
Bar iron	488,834	663,211
Rod iron	26,087	145,626
All kinds of plate iron	284,702	437,139
Sheet iron	74,753	94,992
Iron rails	531,605	466,917
Skelp iron	2,217	128,321
Muck bar made for sale to other works	33,631	64,469
Other products	--------	352,573
Total	1,441,829	2,353,248

The item of muck bar is an unavoidable duplication, as it undoubtedly reappears as finished iron to be counted a second time. Further details of the rolling-mill products in the census year 1870 than have been given above can not be ascertained.

The 352,573 tons of "other products" in the column for 1880 include 96,810 tons of structural iron; 2,630 tons of rolled axles; 96,843 tons of hoop iron; 48,345 tons of fish plates and miscellaneous forms of rolled iron; 82,358 tons of railroad spikes, wire, horse-shoes, rivets, etc., made in rolling mills that rolled the bar and rod iron of which they were manufactured, but which iron is not duplicated in this statement; 21,884 tons of hammered axles; and 3,703 tons of forgings.

In the Bessemer and open-hearth steel works of the country the following finished products were produced in the census year 1880:

FINISHED PRODUCTS.	Bessemer Steel. Net Tons.	Open-hearth Steel. Net Tons.
Rails	741,475	9,105
Bars	76,710	43,296
Rods	49,064	1,134
Shapes	557	80
Sheets	--------	1,700
Plates	1,475	11,034
Other forms	20,615	26,794
Total	889,896	93,143

The Bessemer and open-hearth steel works in the census year 1880 produced 985,208 tons of Bessemer steel ingots and 84,302 tons of open-hearth steel ingots.

GEOGRAPHICAL DISTRIBUTION OF THE IRON AND STEEL INDUSTRIES OF THE UNITED STATES.

The whole territory of the United States may be regarded as comprising four grand divisions—the Eastern States, the Southern States, the Western States and Territories, and the Pacific States and Territories. Assuming that the Eastern States comprise all of the States lying north of Delaware and east of Ohio, that the Southern States comprise all of the late slaveholding States

except Missouri, and that the other divisions require no explanation, we present the following comparative statement of the development of the iron and steel industries in each of the grand divisions in the the census year 1880:

GRAND DIVISIONS.	No. of establishments.	Capital Invested.	Hands employed.	Wages Paid.	Net Tons Produced.	Value of all Products.
Eastern States	556	$149,507,461	82,842	$34,361,660	4,671,808	$192,696,010
Southern States	218	29,145,830	20,595	6,261,344	649,153	25,353,251
Western States and Territories	224	50.755,990	36,663	14,542,587	1,912,689	76,933,686
Pacific States and Territories	7	1,562,603	878	311,194	31,490	1,574,738
Total United States	1,005	$230,971,884	140,978	$55,476,785	7,265,140	$296,557,685

In 1870 there was 25 States engaged in the manufacture of iron and steel. Of these, South Carolina does not appear in the statistics for 1880. Its total production in 1870 did not aggregate 500 tons. The iron industry in this State has been practically abandoned. Since 1870 three States have for the first time engaged in the manufacture of iron, namely, Colorado, Kansas, and Nebraska; also two Territories, namely, Utah and Wyoming. Utah did not, however, make any iron in 1880. It made a small quantity in each of the years 1874, 1875, and 1876, and it will make a larger quantity in the near future. California and Washington Territory have made arrangements since the close of the census year 1880 to manufacture iron. New Hampshire made iron many years ago, but it does not appear in the statistics for 1870; it reappears in the tables for 1880. Oregon and Texas each built a blast furnace in the decade preceding the census year 1870, but they did not make any iron in that year; they appear, however, in the statistics of production for 1880. The District of Columbia once had a blast furnace in operation, but in 1870 it had no iron industry whatever; in 1880 the United States Government owned and operated a small rolling mill at the Washington Navy Yard. Minnesota appears in 1880 for the first time among iron-manufacturing States, but its statistics relate only to the preparations that have been made to embark in the business. Thirty States, the District of Columbia, and Wyoming Territory actually made iron in 1880.

COMPARATIVE PRODUCTION OF ALL THE STATES IN 1870 AND 1880.

Twelve States made over 100,000 tons each in 1880. Pennsylvania, which for more than a hundred years has been the leading iron-producing State in the Union, made in 1870 a fraction over 50 per cent of the total product, and in 1880 it made a fraction over 49 per cent. At both periods its prominence in the production of iron and steel was virtually the same. From 1870 to 1880 it increased its production 97 per cent, or from 1,836,808 tons to 3,616,668 tons, while the whole country increased its production 99 per cent, or from 3,655,215 tons to 7,265,140 tons. Ohio was the next State in prominence in 1870, and it held the same rank in 1880. In the former year it produced 449,768 tons, and in 1880 it produced 930,141 tons, an increase of 107 per cent. The third State in prominence in 1870 was New York, and it maintained this rank in 1880, but its growth fell far below that of its two sister States above mentioned. In 1870 it produced 448,257 tons, and in 1880 it produced 598,300 tons, an increase of 33 per cent. New Jersey was fourth in rank in 1870, producing 115,262 tons, but it was fifth in 1880, although in that year it produced 243,860

tons, an increase of 112 per cent. The fourth place in 1880 was taken by Illinois, which produced in 1870 only 25,761 tons, while in 1880 it produced only 417,967 tons, an increase of 1,522 per cent. Maryland ranked fifth in 1870, producing 95,424 tons in that year, while in 1880 it produced only 110,934 tons, an increase of 16 per cent, causing it to drop to the twelfth place. The sixth State in rank in 1870 was Missouri, with a production of 94,890 tons, which was increased to 125,758 tons in 1880, or 33 per cent, giving it the tenth place in that year. Michigan increased its production in the ten years from 86,679 tons to 142,716 tons, or 65 per cent, taking the eighth place in rank in 1880. Wisconsin increased its production from 42,234 tons to 178,935 tons, or 324 per cent, giving it the sixth place in 1880. Indiana produced 64,148 tons in 1870, and 96,117 tons in 1880, an increase of 50 per cent. Of the New England States, Massachusetts shows the greatest growth in the ten years, increasing from 86,146 tons in 1870 to 141,321 tons in 1880, or 64 per cent, placing it ninth in rank. Astonishing progress was made in the ten years in several southern States. West Virginia increased its production from 72,337 tons to 147,487 tons, or 104 per cent, giving it the seventh place in 1880. Alabama increased from 7,060 tons to 62,986 tons, or 792 per cent. Georgia increased from 9,634 tons to 35,152 tons, or 265 per cent. Tennessee increased from 34,305 tons to 77,100 tons, or 125 per cent. Kentucky increased from 86,732 tons to 123,751 tons, or 43 per cent, placing it eleventh in rank in 1880. Delaware increased from 8,307 tons to 33,918 tons, or 308 per cent. Virginia increased from 37,836 tons to 55,722 tons, or 47 per cent. All the States which made iron or steel in 1870 increased their production in 1880, except Maine, North Carolina, and South Carolina. The relative rank in production of all the States in 1870 and in 1880 is given in the following table:

STATES.	Production, 1880.	Rank.	STATES.	Production, 1870.	Rank.
Pennsylvania	3,616,668	1	Pennsylvania	1,236,808	1
Ohio	930,141	2	Ohio	449,768	2
New York	598,300	3	New York	448,257	3
Illinois	417,967	4	New Jersey	115,262	4
New Jersey	243,860	5	Maryland	95,424	5
Wisconsin	178,935	6	Missouri	94,890	6
West Virginia	147,487	7	Kentucky	86,732	7
Michigan	142,716	8	Michigan	86,679	8
Massachusetts	141,321	9	Massachusetts	86,146	9
Missouri	125,758	10	West Virginia	72,337	10
Kentucky	123,751	11	Indiana	64,148	11
Maryland	110,934	12	Wisconsin	42,234	12
Indiana	96,117	13	Virginia	37,836	13
Tennessee	77,100	14	Tennessee	34,305	14
Alabama	62,986	15	Illinois	25,761	15
Virginia	55,722	16	Connecticut	25,305	16
Connecticut	38,061	17	Maine	17,138	17
Georgia	35,152	18	Georgia	9,634	18
Delaware	33,918	19	Delaware	8,307	19
Kansas	19,055	20	Alabama	7,060	20
California	14,000	21	Rhode Island	4,415	21
Maine	10,866	22	California	3,000	22
Territory of Wyoming	9,790	23	North Carolina	1,801	23
Rhode Island	8,134	24	Vermont	1,525	24
New Hampshire	7,978	25	South Carolina	443	25
Vermont	6,620	26	Kansas	----------	----------
Colorado	4,500	27	Territory of Wyoming	----------	----------
Oregon	3,200	28	New Hampshire	----------	----------
Nebraska	2,000	29	Colorado	----------	----------
Texas	1,400	30	Oregon	----------	----------
North Carolina	439	31	Nebraska	----------	----------
District of Columbia	264	32	Texas	----------	----------
South Carolina	----------	----------	District of Columbia	----------	----------

CENTERS OF IRON AND STEEL PRODUCTION IN THE UNITED STATES IN 1880.

In the following table is presented a view of the principal "centers" of production of the iron and steel industries of the United States in the census year 1880. These "centers" are divided into two classes—the first comprising all counties which produced over 100,000 net tons of pig iron and finished products, and the second comprising all counties which produced over 60,000 and less than 100,000 tons. In the first class are fifteen counties, and in the second class are seventeen counties. Six States are represented in the first class, and eight States in the second class:

COUNTIES OF THE FIRST CLASS, PRODUCING OVER 100,000 TONS OF PIG IRON, ROLLED IRON, STEEL, AND BLOOMS.

Counties.	Net Tons.
1. Allegheny county, Pa.	848,146
2. Lehigh county, Pa.	324,875
3. Northhampton county, Pa.	322,882
4. Cambria county, Pa.	260,140
5. Cook county, Ill.	248,479
6. Dauphin county, Pa.	223,676
7. Mahoning county, Ohio	219,957
8. Berks county, Pa.	213,580
9. Cuyahoga county, Ohio	210,350
10. Mercer county, Pa.	182,881
11. Rensselær county, N. Y.	177,967
12. Montgomery county, Pa.	168,628
13. Lackawanna county, Pa.	151,273
14. Milwaukee county, Wis.	128,191
15. St. Louis county, Mo.	102,644
Total (15 counties)	3,783,673

COUNTIES OF THE SECOND CLASS, PRODUCING BETWEEN 60,000 AND 100,000 TONS OF PIG IRON, ROLLED IRON, STEEL, AND BLOOMS.

Counties.	Net Tons.
1. Lawrence county, Pa.	88,443
2. Lancaster county, Pa.	87,019
3. Ohio county, W. Va.	84,767
4. Will county, Ill.	84,094
5. Montour county, Pa.	79,789
6. Chester county, Pa.	78,363
7. Warren county, N. J.	76,622
8. Trumbull county, Ohio	73,369
9. Lebanon county, Pa.	73,149
10. Lawrence county, Ohio	70,794
11. Schuylkill county, Pa.	70,609
12. Baltimore county, Md.	79,944
13. Blair county, Pa.	68,039
14. Essex county, N. Y.	66,725
15. Philadelphia county, Pa.	65,983
16. Wayne county, Mich.	63,584
17. Dutchess county, N. Y.	61,637
Total (17 counties)	1,262,894

THE CENTER OF TOTAL PRODUCTION.

The geographical center of production of the iron and steel industries of the United States in the census year 1880 has been made the subject of a very careful calculation by Mr. George W. Cope, my principal assistant in the collection of the statistics which are condensed in this preliminary report. The center of production is the point at which equilibrium would be reached were the country taken as a plain surface, itself without weight, but capable of sustaining weight, and loaded with its production of iron and steel, each ton exerting pressure on the pivotal point directly proportional to its distance therefrom.

The centre of production of iron and steel in the United States in the census year 1880 was found to be at 40° 43′ north latitude and 79° 20′ longitude west from Greenwich. This point is in the State of Pennsylvania, on the boundary line between Armstrong and Indiana counties, and about 12 miles northeast of Apollo and 12 miles west of the town of Indiana—Laufman & Co.'s rolling mill at Apollo being the nearest iron works. At the center of production thus ascertained iron has never been manufactured in any form.

MINERAL PRODUCTS USED BY THE IRON AND STEEL WORKS OF THE UNITED STATES.

It is necessary to explain that the figures of "hands employed" and "wages paid" refer to the labor directly employed at the various iron and steel works of the country and in the mining and other operations conducted in direct connection with these works. They do not include the labor employed in

independent and often remote mining operations which supply our iron and steel industries with ore and coal and other raw materials. The statistics of these operations are being compiled by other hands. If the "hands employed" and "wages paid" in these independent mining operations were added to the figures given in our tables, the total number of persons directly supported by our iron and steel industries in 1880, and the total amount of wages paid to them, would be largely increased. This will be made plain by the presentation in the following table of the quantities of mineral products used by the iron and steel works of the country in 1880:

WORKS.	Iron Ore. Net Tons.	Limestone. Net Tons.	Anthracite Coal. Net Tons.	Bituminous Coal. Net Tons.	Coke. Net Tons.
Blast furnaces	7,256,684	3,169,149	2,615,182	1,051,753	2,128,255
Rolling mills	363,959	----------	526,126	3,915,377	14,834
Bessemer and open-hearth steel works	7,327	----------	140,458	465,655	104,980
Crucible steel works	2,128	----------	40,392	224,657	22,791
Forges and bloomaries	79,610	----------	340	1,613	6,695
Total	7,709,708	3,169,149	3,322,498	5,659,055	2,277,555

Of the iron ore and limestone given in the table, at least one-half was purchased from independent producers; of the anthracite coal, nearly all was so purchased; and of the bituminous coal and coke, fully two-thirds was so purchased.

CERTAIN RAW MATERIALS USED IN THE MANUFACTURE OF IRON AND STEEL.

To the above are added below tables showing the quantities of all other leading raw materials used in the census year 1880 in the manufacture of iron and steel:

WORKS.	Bushels of Charcoal.	Mill Cinder. Net Tons.	Pig Iron. Net Tons.	Old Iron Rails. Net Tons.	Scrap Iron. Net Tons.	Ore Blooms. Net Tons.	Pig or Scrap Blooms. Net Tons.	Muck Bar Purchased. Net Tons.
Blast furnaces	53,909,828	354,048	----------	----------	----------	----------	----------	----------
Rolling mills	2,569,756	--------	1,574,693	708,534	422,282	14,147	46,861	53,754
Bessemer and Open-hearth steel works	37,552	--------	966,603	--------	13,911	16,053	250	--------
Crucible steel works	60,594	--------	17,226	--------	1,952	13,211	2,400	--------
Forges and bloomaries	13,014,361	--------	38,113	--------	8,933	--------	--------	--------
Total	69,592,091	354,048	2,596,635	708,534	447,078	43,411	49,511	53,754

WORKS.	Spiegeleisen. Net Tons.	Old Steel Rails and Crop Ends. Net Tons.	Bessemer Steel Ingots and Blooms Purchased. Net Tons.	Open-hearth Ingots and Blooms Purchased. Net Tons.	Scrap Steel. Net Tons.	Swedish Billets and Bars. Net Tons.	Other Billets and Bars. Net Tons.	Barrels of Oil Used as Fuel.
Bessemer and Open-hearth steel works	86,138	85,653	42,939	17,713	90,645	--------	--------	--------
Crucible steel works	----------	--------	----------	--------	19,726	10,410	16,496	--------
Forges and bloomaries	----------	--------	----------	--------	--------	--------	--------	853
Total	86,138	85,653	42,939	17,713	110,371	10,410	16,496	853

TABLE A.—*Grand Aggregate for the United States of all Blast Furnaces, Rolling Mills, Steel Works, and Forges and Bloomaries, with their Division among the Four Leading Sections.*

STATES AND TERRITORIES.	No. of establishments in the census year 1880.	Capital invested in the census year 1880.	Hands Employed and Wages Paid in the Census Year 1880.						Value of all materials used in the census year 1880.	Value of all products made in the census year 1880.	Weight of all products made in the census year 1880. Net tons.	Weight of all products made in the census year 1870. Net tons.
			Males above sixteen years.	Males below sixteen years.	Females above fifteen years.	Females below fifteen years.	Total hands employed.	Total amount paid in wages.				
EASTERN:												
Maine	3	$450,000	683	17	.....	.....	700	$141,494	$380,511	$583,328	10,866	17,138
New Hew Hampshire	2	650,000	289	1	.....	.....	290	127,690	523,355	807,340	7,978	.....
Vermont	4	410,000	190	1	.....	.....	191	50,035	240,900	392,300	6,620	1,525
Massachusetts	30	6,738,408	6,367	125	21	.....	6,513	2,576,539	6,657,232	10,288,921	141,321	86,146
Rhode Island	3	630,000	200	75	.....	.....	275	130,969	375,347	488,040	8,134	4,415
Connecticut	19	2,682,000	663	22	.....	.....	685	331,184	1,341,225	1,998,698	38,061	25,305
New York	89	21,543,221	10,697	747	.....	.....	11,444	4,099,451	13,395,229	22,219,219	598,300	448,257
New Jersey	40	9,099,050	4,711	81	.....	.....	4,792	1,808,448	6,556,283	10,341,896	243,860	115,262
Pennsylvania	366	107,304,782	54,637	3,297	12	6	47,952	25,095,850	92,267,030	145,576,268	3,616,668	1,836,808
Total	556	$149,507,461	78,437	4,366	33	6	82,842	$34,361,660	$121,737,112	$192,696,010	4,671,808	2,534,856
SOUTHERN:												
Delaware	9	$1,431,469	818	49	.....	.....	867	$344,476	$1,214,050	$2,347,177	33,918	8,307
Maryland	23	4,962,125	2,656	107	.....	.....	2,763	905,090	2,888,574	4,470,950	110,934	95,424
District of Columbia	1	89,600	18	.....	.....	.....	18	7,528	2,264	10,970	264	.....
Virginia	44	4,329,713	2,399	121	2	.....	2,522	665,432	1,496,151	2,585,999	55,722	37,836
North Carolina	20	759,400	63	.....	.....	.....	63	7,907	11,792	41,085	439	1,801
Georgia	14	1,135,900	1,266	37	.....	.....	1,303	185,489	631,707	990,850	35,152	9,634
Alabama	14	3,309,196	1,581	45	.....	.....	1,626	571,713	601,073	1,452,856	62,986	7,060
Texas	1	40,000	140	.....	.....	.....	140	27,720	23,580	36,000	1,400	.....
West Virginia	20	3,913,616	3,780	341	.....	.....	4,121	1,541,816	3,484,625	6,054,032	147,487	72,337
Kentucky	29	5,493,035	3,831	264	.....	.....	4,095	1,344,400	3,223,799	5,090,029	123,751	86,732
Tennessee	43	3,681,776	2,758	309	10	.....	3,077	659,773	1,376,059	2,274,203	77,100	34,305
South Carolina	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	443
Total	218	$29,145,830	19,310	1,273	12	.....	20,595	$6,261,344	$14,953,674	$25,353,251	649,153	353,879

TABLE A.—*Grand Aggregate for the United States of all Blast Furnaces, Rolling Mills, Steel Works, and Forges and Bloomaries, with their Division among the Four Leading Sections.—Continued.*

STATES AND TERRITORIES.	No. of establishments in the census year 1880.	Capital invested in the census year 1880.	Hands Employed and Wages Paid in the Census Year 1880.						Value of all materials used in the census year 1880.	Value of all products made in the census year 1880.	Weight of all products made in the census year 1880. Net tons.	Weight of all products made in the census year 1870. Net tons.
			Males above sixteen years.	Males below sixteen years.	Females above fifteen years.	Females below fifteen years.	Total hands employed.	Total amount paid in wages.				
WESTERN:												
Ohio	134	$25,141,294	18,885	1,171	.....	15	20,071	$8,265,070	$23,997,915	$34,918,360	930,141	449,768
Indiana	12	2,283,000	1,883	165	.....	.....	2,048	864,921	3,293,073	4,551,403	96,117	64,148
Illinois	21	6,460,620	4,887	366	.....	.....	5,253	2,508,718	14,977,145	20,545,289	417,967	25,761
Missouri	22	9,152,472	2,989	150	.....	.....	3,139	734,575	3,249,558	4,660,530	125,758	94,890
Michigan	22	4,175,386	3,054	35	.....	.....	3,089	922,597	3,279,420	4,591,613	142,716	86,679
Wisconsin	9	2,843,218	2,088	65	.....	.....	2,153	1,004,931	3,830,667	6,580,391	178,935	42,234
Minnesota	1	150,000	180	.....	.....	.....	180	25,275	.....	.....	.....	.....
Kansas	2	450,000	570	60	.....	.....	630	166,500	734,245	1,004,100	19,055	.....
Nebraska	1	100,000	90	10	.....	.....	100	50,000	114,500	82,000	2,000	.....
Total	224	$50,755,990	34,626	2,022	.....	15	36,663	$14,542,587	$53,476,523	$76,933,686	1,912,689	763,480
PACIFIC:												
Colorado	1	$100,000	125	.....	.....	.....	125	$7,000	$131,700	$225,000	4,500	.....
California	1	1,000,000	284	35	.....	.....	319	177,722	535,500	780,000	14,000	3,000
Oregon	1	100,000	247	3	.....	.....	250	46,822	33,073	78,393	3,200	.....
Utah Territory	3	150,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Wyoming Territory	1	212,603	174	10	.....	.....	184	79,650	403,568	491,345	9,790	.....
Total	7	$1,562,603	830	48	.....	.....	878	$311,194	$1,103,841	$1,574,738	31,490	3,000
Total of United States, 1880	1,005	$230,971,884	133,203	7,709	45	21	140,978	$55,476,785	$191,271,150	$296,557,685	7,265,140	.....
Total of United States, 1870	808	$121,772,074	75,037	2,436	82	.....	77,555	$40,514,981	$135,526,132	$207,208,696	.....	3,655,215
Per cent of increase in 1880	24.38	89.68	77.52	216.46	.....	.....	81.87	36.93	41.13	43.12	98.76	.....
Per cent of decrease in 1880	.....	.....	.....	.....	45.12	.....	.....	.....	.....	.....	.....	.....

TABLB B.—*Production of Pig Iron, Rolled Iron, Steel, and Blooms in the United States in the Census Year 1880.*

STATES.	Net tons of pig iron, including castings direct from the furnace.	Net tons of rolled iron.	Net tons of Bessemer steel ingots.	Net tons of open-hearth steel ingots.	Net tons of crucible steel ingots.	Net tons of blister and other steel.	Net tons of blooms made from ore.	Net tons of blooms made from pig and scrap iron.
Alabama	62,336	650						
California		14,000						
Colorado		4,500						
Connecticut	18,779	16,203			2,116			
Delaware		33,918					102	450
Georgia	23,039	11,501						
Illinois	95,468	117,051	253,514	925	130			
Indiana	18,237	77,880						
Kansas		19,055						
Kentucky	58,108	65,293		275	75			
Maine	2,015	8,851						3,661
Maryland	59,664	47,609						44
Massachusetts	9,543	109,252		9,475	140			
Michigan	119,586	23,130					4,000	
Missouri	95,050	16,508	8,409					
Nebraska		2,000						
New Hampshire		4,752		4,521			523	3,306
New Jersey	157,414	66,030		450	10,492		31,580	138
New York	313,368	163,538	84,160		2,585		439	
North Carolina								
Ohio	548,712	272,094	82,811	24,712	360			
Oregon	3,200						175	24,398
Pennsylvania	1,930,311	1,071,098	556,314	36,944	60,303	3,135		
Rhode Island		8,134					756	345
Tennessee	47,873	25,381		4,000				
Texas	1,400							
Vermont	620	1,590		3,000			58	2,582
Virginia	17,906	35,176						
West Virginia	80,050	67,437						
Wisconsin	118,282	60,653						
District of Columbia		264						
Territory of Wyoming		9,790						
Total	3,781,021	2,353,248	985,208	84,302	76,201	3,135	37,633	34,924

TABLE C.—*Details of Production, Embracing Certain Special Varieties of Iron and Steel Manufactured in the Census Year 1880.*

STATES	Net tons of castings direct from the furnace. Included in Table B.	Net tons of sheet iron. Included in Table B.	Net tons of boiler plate iron. Included in Table B.	Net tons of other plate iron except nail plate. Included in Table B.	Kegs of cut nails of 100 lbs. each. Included in Table B.	Net tons of hoop iron. Included in Table B.	Net tons of iron rails. Included in Table B.	Net tons of Bessemer steel rails.	Net tons of open hearth steel rails.	Total production of all kinds of rails. Net tons.
Alabama						500				
California							6,000			6,000
Colorado							4,500			4,500
Delaware		5,243	1,241	2,482						
Georgia							8,673			8,673
Illinois					222,540		72,802	201,186		273,988
Indiana		6,383	51		280,760		38,600			38,600
Kansas							13,500			13,500
Kentucky	93	4,784	5,375	3,155	210,000	785	18,000			18,000
Maine					4,480	375				
Maryland	20	3,178	6,612	3,702		12	9,280			9,280
Massachusetts			1,879	23,410	490,880	3,983	5,600			5,600
Michigan	86	1,300	4,600							
Missouri								5,100		5,100
Nebraska					40,000					
New Hampshire			100							
New Jersey	80	1,150			296,060					
New York	62			2,750	12,220	3,077	34,305	57,870		92,175
Ohio	1,011	14,440	9,180	7,050	733,940	23,149	41,838	66,480		108,318
Pennsylvania	2,217	54,174	60,519	52,162	1,504,000	64,722	157,213	409,339	3,360	569,912
Tennessee	140				104,180		12,800		2,745	15,545
Vermont							1,500	1,500	3,000	6,000
Virginia	121				101,640					
West Virginia	307	4,340			1,055,900	240	3,333			3,333
Wisconsin	92						29,552			29,552
District of Columbia				38						
Territory of Wyoming							9,421			9,421
Total	4,229	94,992	89,560	94,749	5,056,600	96,843	466,917	741,475	9,105	1,217,497

STATISTICAL TABLE Showing the Tatal Number of Gross Tons of Pig Iron Produced by the Blast Furnaces of Michigan, by Charles E. Wright, M. E., Commissioner of Mineral Statistics.

NAME OF FURNACE COMPANIES.	Previous to 1872.	1872.	1873.	1874.	1875.	1876.	1877.	1878.	1879.	1880.	Totals.
[1] Pioneer Furnaces [a]	57,577	7,020	7,388	10,708	15,202	11,205	2,801	9,768	13,169	18,269	153,107
[1] Iron Cliffs Furnace [a]				4,784	358						5,142
[1] Collins Iron Company‡ [a]	36,566	3,431	2,000								41,997
[1] Northern Iron Company‡ [a]	15,059										15,059
[1] Bancroft Iron Company‡ [a]	35,021	4,250	4,100	3,688	5,277	3,282					55,618
[1] Morgan Iron Company‡ [a]	31,602	4,356	6,324	5,973	5,377	3,278	663				57,573
[1] Champion Iron Company‡ [a]	20,512	5,006	3,949	1,581							31,048
[1] Michigan Iron Company‡ [a]	23,344	4,001	4,467	6,621	3,098						41,531
[1] Greenwood Iron Company‡ [a]	25,140	4,212	4,416	4,839	1,595						40,202
[2] Fayette Furnace [a]	24,626	9,962	11,966	11,079	10,647	10,015	3,969	10,594	8,956	9,739	111,553
[3] Munising Iron Company‡ [a]	7,557	2,500	2,237	6,092	4,239	2,407	3,280				28,312
[3] Bay Furnace‡ [a]	7,095	4,900	8,760	8,359	9,223	8,119	4,250				50,706
[1] Deer Lake Iron Company‡ [a]	7,833	2,720	3,447	6,524	4,615					2,591	27,730
[1] Marquette & Pacific R. M. Co.	1,610	4,954	1,138	3,238	10,940	10,514	6,856			2,609	41,859
[1] *Grace Furnace‡			7,800	3,546							11,346
[1] Carp River Iron Company [a]				1,431		1,272	3,176	4,917	5,529	5,585	21,910
[1] Excelsior (Peat Furnace)		115	509							847	1,571
[4] Menominee Iron Company [a]			2,299	4,702	5,780	4,829	5,647	3,034	6,750	7,776	40,817
[2] Escanaba Furnace Company [a]			2,175	5,803	70						8,048
[5] Michigan Central Iron Company [a]	19,518	3,551	4,848	3,451	1,230						32,598
[5] Bangor Furnace Company [a]		689	3,606	6,219	8,359	10,280	10,957	11,503	11,940	13,405	76,958
[6] Peninsular Iron Company [a]	33,752	4,834	4,533	2,049	2,460	2,472	5,310	5,254	7,683	§ 7,500	75,847
[6] Eureka Furnace [a]	60,000	2,078	3,572	549	2,255	3,421	4,458	528	9,395	15,925	102,181
[7] Leland Furnace [a]						3,000	2,000				5,000
[8] Frankfort Furnace [a]			† 6,200	3,656	4,061						13,917
[9] Elk Rapids Furnace [a]				5,863	8,033	7,100	11,925	12,448	12,477	12,384	70,230
[6] Detroit & L. S. Iron Manufacturing Company	36,494	4,731	4,061	3,808	4,831	1,580	4,805	1,437	4,767	7,149	73,663
[6] Union Iron Company [a]		1,421	4,990	1,670	2,916	3,680	4,278	5,547	8,797	4,949	38,248
Totals	443,306	74,731	104,785	116,233	110,566	86,454	74,375	65,030	89,463	108,728	1,273,772

[1] Furnaces in Marquette County.
[2] Furnaces in Delta County.
[3] Furnaces in Schoolcraft County.
[4] Furnace in Menominee County.
[5] Furnaces in Van Buren County.
[6] Furnaces in Wayne County.
[7] Furnace in Leelanaw County.
[8] Furnace in Benzie County.
[9] Furnace in Antrim County.
‡ Swineford's History.
† Previous to 1874.
* Coal or Coke.

Caseville Furnace—No returns.
Ward Furnace—No returns previous to 1878.
Hamtramck Furnace—Not in blast since 1873.
[a] Charcoal.
§ Estimated.

TABLE Showing the Amount of Coal Produced in Michigan for 1877-78-79-80, and Total for Previous Years, Partly Estimated.

	Previous to 1877.	1877.	1878.	1879.	1880.
Jackson mines	----------	67,697	61,785	†65,000	66,170
Corunna mines	----------	----------	22,537	16,215	12,252
Other mines	----------	1,500	1,000	800	†1,000
Total net tons	350,000	69,197	77,715	82,015	79,422

†Estimated.

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